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THE AMERICAN
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# EDITORIAL

## CLINICAL LABORATORY SERVICE FOR PHYSICIANS.

The editorial which appears herewith is reprinted from the official organ of the American Medical Association because it is our belief that it gives utterance to statements which will not bear a keen analysis without disclosing an unfair attitude of mind in its writer, We do not take it that it reflects the consensus of opinion of the entire medical profession as we know it, but rather that it is the more narrow viewpoint of a limited element of that honorable profession. And it is rather unfortunate that a message such as this should find so potential and powerful a courier as the editorial column of this widely circulated journal.

Clinical laboratories are undoubtedly becoming more common and their fields of service are daily becoming more extensive. Whether this extension is to continue is a matter of doubt, however, since it is quite believable that this hectic day of diagnosing with a test-tube and slide is bound to be sensibly displaced by a return to the saner practice of considering the patient *per se* and using the eye and the mind oftener than the tube and the slide.

However, the clinical laboratory will always have its sphere of usefulness, and it is but natural that proper precautions shall be observed to insure the establishment of only such institutions as shall offer honest, accurate and reasonably priced service. According to this appended editorial this can only be done provided such laboratories are medically managed.

According to our understanding a clinical laboratory can profitably exist only if it gives the proper kind of service. No clinical laboratory, whether controlled by physicians or otherwise, can ever maintain a profitable career unless it observes the most scrupulous

regard to ethics and to honest and correct as well as reasonably priced service. That laboratory which is inaccurate soon falls by the wayside for its patrons promptly lose confidence in it. Consequently it is readily seen that there is no need for a frenzied rush to save this adjunct of medicine from falling into the hands of quacks and charlatans.

Anent the need for limiting this work to physicians only, at least the management commercially or otherwise, we can see no reason why the doctor is better qualified for this than many others.

The actual fact is that it is not lack of time, as stated in this editorial, but rather lack of information and initiative, which prevents the average practitioner from conducting even the most elemental of these clinical tests. "Work which should be done by physicians is being entrusted to incompetent substitutes." This is not often the truth. May we not recall this incident to prove our point? The scene is an army laboratory. A medical lieutenant, who is sponsor for the truth of the tale is looking through the microscope upon a field representing part of a stained smear. He has been informed by the technician (a graduate of a college of pharmacy) that the field shows the spiral organism and its complementary fusiform bacillus of Vincents' angina. Along struts the major, the nominal chief of the laboratory. With military deference the lieutenant under request stands aside while the major glances at the field. The glance is sufficient to give this self-sufficient gentleman proof enough to warrant the opinion that "here we have the treponema pallidum." The technician and the lieutenant are wise enough and experienced enough to hide their humor till another day, and the chief of the laboratory departs satisfied with his day's work. And so it happens frequently, and these experiences are not by and means confined to army laboratories.

"Physicians are responsible to their patients, *i. e.*, the public, for the character of laboratory service supplied. The results of tests and examinations must be accurate; the fees for such tests must be equable."

Of course this is justice, but are these ends to be gained by affording the control of these laboratories to physicians only? Might this altruism not carry the physician into other phases of activities so that no one but physicians remain privileged to dispense drugs, to massage, to manufacture crutches, trusses and such appliances kindred to the doctor's work and necessary for his patients?

The physician of today, referring to the younger men, are avowedly better trained from the laboratory standpoint than their older confreres. But to specialize in this work requires a basic training in science and exactness, in chemistry and physics, in mathematics and in chemical manipulation, far superior even to that which is received by the medical graduate of today. Is it not true that most of our prominent physiologic chemists of the day are not physicians, but scientists trained along entirely different lines, and for that reason more eminently fitted for their respective work? One need only mention Hawk, Dakin, Benedict, and many others. Let us consult the list of authors in the current issue of the JOURNAL OF BACTERIOLOGY, OF GENERAL PHYSIOLOGY, or OF BIOLOGICAL CHEMISTRY, and it is promptly noted that not one-half of the ablest writers are physicians. Nor is it impertinent to recall that the greatest advances in medical history have followed the devices and discoveries of men quite foreign to the profession. Should the world have been denied the marvellous discoveries of the great Pasteur because he was not a physician? No indeed! for to change the whole vista of medicine and surgery "Heaven trained a pure scientist, who had never handled a scalpel nor written a prescription, took this non-medical man of science and set him to be the head of all the heads of the medical profession, to have them all obedient to his teachings and proud of the very sound of his beloved name." That is the story of Pasteur.

The directors of many hospital laboratories in this vicinity are not medical men, but trained chemists and serologists specifically trained in their respective fields and thus privileged to offer the finest kind of service. A casual canvass of the commercial clinical laboratories, extensively patronized by physicians, shows a similar condition and it bespeaks credit to these institutions for their survival is ample proof of their fitness. It also proves our contention that the conduct of these laboratories is not essentially "the function of the organized medical profession."

The editorial to which we refer is herewith appended.

"Laboratory methods now play a large part in the daily work of physicians. Chemical, morphologic, bacteriologic and serologic methods, as well as the roentgen ray, are in daily use everywhere, and new methods, for example, the electrocardiographic determinations and tests of metabolism, are being introduced. To meet the constantly growing needs for such methods, there have come into existence laboratories of health departments and of hospitals, with more or less differentiation into separate departments; also wholly private laboratories. The latter group includes those frequently re-

ferred to as commercial, because dependent on fees, and the individual establishments of physicians working alone or associated in groups. The old-time pathologist, the prototype of the modern laboratory physician, whose function in clinical diagnosis was to determine the nature of lesions from gross and microscopic examination of tissues, has undergone differentiation into clinical chemist, clinical bacteriologist, clinical serologist, clinical microscopist, and roentgenologist, and there has come forth a formerly unknown adjunct to medical practice, the laboratory technician. So rapid has been the evolution of the clinical laboratory and the extension of laboratory methods in all fields of medicine, that frequently fear is voiced lest much work that should be done by physicians is being entrusted to incompetent substitutes.

"Analyzing the situation, we must reckon first with the fact that the great majority of private practitioners for various reasons, lack of time being an important one, are prevented from making any but the simplest routine tests themselves. Therefore they must turn to some one for help, and the privately owned laboratories offer their services. That there has been an increasing demand for this form of laboratory service is evident from the number of laboratories that have sprung up and developed in recent years. Secondly, it appears that we shall be dependent on this kind of laboratory service for some time at least.

"The laboratory features of the proposed health centers or of institutions financed and controlled by the community are attractive to many physicians and are idealistic. They represent a condition in which the same type of service would be rendered to all of the physicians in the community, the cost being reasonable and equally distributed. It might, however, be subject to the charge of representing a further intrusion by the State into medical activities. In any case, the commercial laboratory is an actual fact in our medical practice today. This being the case, the organization, methods and control of such laboratories should receive serious consideration. Physicians are responsible to their patients, *i. e.*, the public, for the character of laboratory service supplied. The results of tests and examinations must be accurate; the fees for such tests must be equable. The conditions in some of these laboratories are such that thoroughly competent and well-trained physicians have been attracted by the work. It is desirable that similar conditions develop in all laboratories, so that well-trained physicians, and not incompetent technicians, become responsible for laboratory service. These things can be achieved only by satisfactory control. Through this control the laboratories will be capable of rendering services of great value to the medical profession, and those institutions not rendering such service may be suppressed. Any effort whereby clinical laboratories are brought up to reasonable and fair standards is to be commended. As to the ideal method of control, there can be no difference of opinion; it should be the function of the organized medical profession."—From the *Journal American Medical Association*, November 5.

I. G.

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## THE BLESSED PRIVILEGE OF WAITING.

I stood beside a man the other day who stared through the crystal of the book case at the drab green-covered volumes of Barton's Flora. Outside crisp snowflakes played merry tunes on the frozen strands of a winter wind. The earth about glistened with immaculate whiteness, and men preferred to stay close to crackling coals so biting and chill was the weather. The man slowly lifted his gaze

from the flower books and said, "Let us go botanizing, boy," and promptly from the hearts of both of us there rushed a passion that sent blood cells caroming to every peripheral corner. For we two had tasted before the blessed privilege of field communion, and we had walked together in languid happiness through avenues of tall trees skirted with a myriad blossoms. Together we had long since learned that the Lord lingers close by His flowers, and that the open hearted can always find Him there.

But, soliloquizes a reading Thomas, how botanize when the pond where lilies live is locked in rigid iciness, and the murmuring brook whose moist banks kept sweet the violet and the modest gold-cup, runs silently through awkward rifts of sodden snow. The feathered folk have travelled far away to sing their songs to other ears, and only the chirping sparrow and the raucous crow remain behind to pick our crumbs and keep our company. The breezes of evening no longer carry on their wings the fragrance of the honey-suckle, and the warm amours of the pines, but only a chilly crispness and a smell of soot and sulphur.

But the man who saith "Let us go botanizing, boy," is a Man of Hope, and his words came to being so spontaneously that I knew that his eye peered through the mantle of snow and saw a dainty blossom, waiting for its day of unfolding. To him the migrating robin red breast sings only wearily on the mesquite down Mexico way, and it longs and longs and longs to come home with Spring, to be once again the joyous, vigorous song bird of the Philadelphia morning.

He knows full well that the frost on the lily pond will vanish with Spring. He knows that the violet beneath its snow coverlet only sleeps, and that morning will soon come when it will yawn itself into a fragrant existence. He knows also that the breeze of the evening will again carry to his soul the breath of sweet flowers; that the feathered folk who flew away will come again another day, to sing in sweeter tones than ever their God directed melodies.

For it is Faith in a return of the Flowers, Hope for health to live and enjoy them, and Love of Nature and its God-director—Faith, Hope and Love, these three—that makes it possible for this man even in the dismal days of winter to say,

"Boy, let's go out among the flowers."

I. G.

# ORIGINAL PAPERS

## SODIUM HYDROSULFITE.

By FREDERICK W. HEYL and FRANK E. GREER.*

There exists a voluminous literature [1] concerning derivatives of hydrosulphurous acid ($H_2S_2O_4$) and its reduction product sulfoxylic acid ($H_2SO_2$), but it is confined almost exclusively to the patent literature. Neither of these is known in the form of the acid. The sodium salt of the former and the sodium salt of formaldehyde sulfoxylic acid ($CH_2OH.OSO\ Na$) are important commercial reducing agents. The preparation and stabilization of these and their varied use in textile printing and dyeing is the subject of several hundred patents.

With the discovery by Ehrlich and Bertheim [2] of the reduction of arsanilic acid to p. amino-phenyl arsenoxid, and to diaminoarsenobenzol by means of sodium hydrosulfite this reagent becomes of interest beyond the textile field. In fact it is a reducing agent capable of very general use, having been successfully employed twenty years ago [3] for the reduction of certain nitrophenols.

Sodium formaldehyde sulfoxylate, aside from its value as a reducing agent, has the power of condensing with aromatic amines [4] to form soluble neutral derivatives of the amines, but at the same time producing marked alteration in the pharmacological nature of the original base, as *e. g.* in neoarsphenamine. This reaction is usually represented as follows:

$$X.NH_2 + HO.CH_2.\ OSO\ Na \rightarrow X.NH\ CH_2OSO\ Na.$$

This condensation of aromatic amines with sodium formaldehyde sulfoxylate gives a product which will not reduce indigo-carmine in

*Holder of The Upjohn Coöperative Fellowship at Kalamazoo College (1920-1921). This paper is based upon the thesis presented by Mr. Greer to the Faculty of Kalamazoo College, in partial fulfillment of the requirements for the degree of Master of Science.

[1] Jellinek, *Das Hydrosulfit*, 2 Vol. (1911).

[2] B. 43, 917 (1910).

[3] Chem. Zent. 1, 1014 (1900).

[4] Reinking, Dehnel, Labhart B. 38, 1069 (1905).

the cold [5], although some reduce indigo in the cold if acid is present. According to Binz and Marx [6] the condensation between the salts of the bases and sodium formaldehyde sulfoxylic acid proceeds in two phases.

(1) R. $NH.{}_2HCl$ + HO $CH_2O$ SO Na → R.NH. $CH_2$ OSOH.

(2) R. NH. $CH_2$ OSOH + R. $NH_2$. HCl → R.$NHCH_2$ $OSONH_3$. R.

There is thus formed an insoluble ammonium salt. In the preparation of neoarsphenamine there is obtained from the reaction mixture small amounts of material insoluble in sodium carbonate. This material probably represents substances of the salt type. (2) In any event the detailed study of this substance requires eminently pure sulfoxylate, and the use of commercial sulfoxylate through the presence of impurities further complicates the study of the reaction.

In the same way the production of arsphenamine requires proportionately large quantities of hydrosulfite for the reduction of 3-nitro-4 hydroxyphenylarsinic acid. According to the Ehrlich process, 263 g. would require 3930 g. commercial sodium hydrosulfite (80%)

$$2(NO_2)\ (OH)\ C_6H_3\ As\ O(OH)_2 = 10\ Na_2S_2O_4.$$
$$263 \qquad\qquad = 870$$

or about 3.6 times the theoretically required amount. It appeared to us that the chemical variability of the product might be due not so much to the arsinic acid, which is prepared analytically pure, but rather to the reagent which is not only impure, containing unknown substances but which is known to react in a secondary manner to produce organic sulphur compounds in variable quantities.[7]

It was therefore desirable to review the patent literature and arrive at a laboratory method for the production of these reagents. The object of this paper is to describe the production of these substances and their properties. We obtained most satisfactory products by first producing crude sulfoxylate by D. R. P. 256, 460. (1913). This was purified by recrystallization. From pure sulf-

[5] Reinking, B., 38, 1074 (1905).
[6] B., 43, 2344 (1910).
[7] *J. Chem. Soc.* 117, 370 (1920).

oxylate, the anhydrous hydrosulfite was prepared by the reaction discovered by Bazlen.[8]

$CH_2OH\ OSONa + 2\ NaHSO_3 \rightarrow Na_2S_2O_4 + HCHO.\ NaHSO_3$.

The original experiment however leads to the highly unstable crystalline hydrate $Na_2S_2O_4.\ 2H_2O$, but by modification to the extent of carrying the reaction out at a temperature of 70° (above the transition point, 52°) the anhydrous salt is precipitated by salting out.[9]

While this is not as economical as the direct production of hydrosulfite by the reduction of bisulfite with zinc, it will be found to be better adapted for the laboratory scale as the product requires no purification whatever, and is free from zinc, and is invariably permanent.

EXPERIMENTAL.

*Preparation of Sodium Formaldehyde Sulfoxylate.*—This is produced smoothly according to D. R. P. 256, 460, the most essential requirement being violent mechanical agitation. 312 g. $NaHSO_3$ (3 mol.), 257 g. formalin (90 g. $CH_2O$) are mixed with the addition of 54 cc. water. Water (500 cc.) is used to further dilute the reaction mixture and to moisten the reducing mixture consisting of zinc dust (360 g.) and zinc oxide. (150 g.) This is gradually added in small portions and the reduction mixture is held at 70°. After the addition of the reduction mixture, the reaction is continued for two hours at 100-105°, with violent agitation. The mixture is filtered and the precipitate washed with hot water. This filtrate concentrated to dryness yields the commercial product.

When the filtrate was concentrated to 400 cc. a crop (A) weighing 347 g. separated. This was redissolved in warm water and fractionated, yielding a top fraction of 56 g. which separated from the warm solution. It had a purity of only 6.2%. The next crops; 22 g., 45 g., and 48 g. were pure sulfoxylate (99%). The fifth crop separating from the warm solution weighed 11 g. and was only 24% sulfoxylate. The sixth crop weighed 33 g. and was 74.4% pure.

The filtrates were joined and concentrated and from the warm solution 20 g. of 16% material was removed by filtration. Then 2

[8] B. 38, 1065 (1905).
[9] U. S. P. 990, 457 (1911).

crops of 59 g. and 51 g. separated. The purity of these was 96% and 81% respectively. The yield of sulfoxylate is about 60%.

For laboratory purposes it is somewhat simpler to reduce the addition product of formaldehyde and commercial hydrosulfite.[10]

($NaHSO_2$. $CH_2O$ $NaHSO_3$. $CH_2O$).

The use of zinc and acetic acid as there directed leads to the presence of acetates and renders the subsequent purification by crystallization more difficult. The following is a practical laboratory process: 400 g. hydrosulfite is dissolved in 400 cc. formalin and 300 cc. water. This is reduced with a mixture of zinc dust (300 g.) and zinc oxide (100 g.), first at 70° and then two hours at 100-105° and with agitation. To the liquid a few drops of sodium carbonate solution are added and the filtrate on concentration always yields a crop of almost pure sulfoxylate. By fractionation yields of 70% are obtained.

Calc. for $NaHSO_2$. $CH_2O$.C = 10.1 : H = 2.5. Found: C = 9.4, 10.0, H = 2.7, 2.55.

In recrystallizing this substance it is desirable to keep the solutions alkaline with $Na_2$ $CO_3$ and to have a small amount of formaldehyde present. The temperature is never allowed to exceed 70° at which temperature this substance is exceedingly soluble. (1 liter dissolves 500-600 g.[11]) Otherwise there is a constant decomposition with the emission of a garlic or mercaptan-like odor.

*Analysis of Sodium Formaldehyde Sulfoxylate.*—$CH_2OH$ OSO Na. $2H_2O$.

This substance is now procurable in a rather high state of purity (85%) on the American market. It may be analyzed readily by the direct titration of a hot solution (acidified with acetic acid) using standardized methylene blue solution. The titrations were carried out in an atmosphere of $CO_2$. The solution is warmed gradually during the titration and not boiled until the end point is reached. In a well conducted titration an excess of methylene blue solution is had at all times until almost at the end point. The titration liquid is taken from the flame just as the color is about to vanish, before each new addition of methylene blue. Reduction does not proceed rapidly until a temperature of about 50-60° is attained.

[10] D. R. P. 165, 807.

[11] Osann, B. 38, 2290 (1905).

Baumann, Thesmar and Frossard[12] analyze sodium formaldehyde sulfoxylate by titrating with an ammoniacal copper sulfate solution in a stream of hydrogen at 55°. This method is satisfactory for routine purposes but does not give results quite as high as the methylene blue procedure.

$$\underset{154}{NaHSO_2.\ CH_2O.\ 2\ H_2O} = \underset{2}{2\ H} = \underset{2(249.6)}{2\ CuSO_4\ 5\ H_2O.}$$

it is advisable to prepare an N/4 solution by dissolving 62.4 g. crystalline copper sulfate in water, adding 200 cc. conc. ammonia water, and making the volume to one liter. Then 1 cc. = 0.01925 g. crystalline sulfoxylate. It is our practice to weigh 0.385 g. of the sample, whence each 0.1 cc. of the $CuSO_4$ solution used is equivalent to 0.5% sulfoxylate, and a sample requiring 20 cc. is 100% pure.

When sulfoxylate is titrated with iodine in neutral solutions a quantity of iodine equivalent to four atoms iodine is required. This is an unsatisfactory method for the analysis of crude products as the impurities are likewise oxidized. Baumann, Thesmar and Frossard have made a distinction between sulfoxylate and sodium formaldehyde bisulfite. They showed that while the latter is not oxidized by iodine in neutral solution it may be in alkaline solution. Hence in this common mixture the end point is first recorded for the sulfoxylate in neutral solution, whereupon the partially titrated fluid is rendered alkaline with sodium bicarbonate and a second volume of iodine is slowly required by the bisulfite compound, but the end point is not sharp.

A sample of analytically pure sodium formaldehyde sulfoxylate (calc: $H_2O$ = 23.4. Found, 23.8) was analyzed in the anhydrous state. (Calc: Na, 19.5: S, 27.12. Found: Na, 19.5 S, 26.75).

0.1174 g. required 39.62 cc. iodine (1 cc. = 0.01283 g. I).
0.1500 g. required 18.75 cc. methylene blue sol. (1 cc. = 0.0058 g. Fe).
0.385 g. required 19.4 cc. N/4 copper sulfate sol.

These results correspond to a purity of 100.7, 99.7, and 97% respectively and indicate the fact that in general the copper titration gives slightly low results.

[12] Rev. Gen. Mat. Color 8, 354 (1904).

*Solubility of Crystalline Sulfoxylate.*—The crystalline product loses its water of crystallization completely when dried in a vacuum over calcium chloride or phosphorous pentoxide. The solubility of the crystalline substance in glycerine was determined.

25 cc. of the saturated solution (18°) weighed 34.2967 g. 5 cc. of this was diluted to 100 cc. and of this 5 cc. was titrated with methylene blue solution. Found: Original 5 cc. = 2.5329 g. sulfoxylate. Therefore 100 cc. of the saturated solution contains 86.5 g. gylcerine plus 50.66 g. sulfoxylate. Therefore 100 cc. glycerine (sp. grav. 1.262) will dissolve about 74 g.

In methyl alcohol the solubility is much lower. 50 cc. of a saturated solution weighs 42.5613 g. By titration 100 cc. contains 8.39 g. sulfoxylate and 76.73 g. methyl alcohol; 100 cc. methyl alcohol (sp. gr. 0.8) will dissolve about 8.8 g. sulfoxylate.

When aqueous solutions of sodium formaldehyde sulfoxylate are treated with barium chloride solutions, either neutral or with one mol. of sodium hydroxide a slight precipitate of the barium salt separates. (3.5% from 5% solutions.) Calcium chloride gives no precipitate in neutral solutions. Both chlorides precipitate sodium sulfite almost completely under the same conditions. Sodium formaldehyde bisulfite is very slightly precipitated by barium chloride, but not by calcium chloride in neutral solutions, but by increasing the alkalinity the baryta forms an insoluble barium salt. Thus in the presence of 0.3 mole sodium hydroxide 67% of the formaldehyde bisulfite was precipitated by barium chloride.

*Effect of Sulfoxylate on Rats.*—A series of intravenous injections into white rats gave the following results:

| Dose milligrams per kilo. | Weight of rat. | Vol. of solution, cc. | Time Seconds. | Result. |
|---|---|---|---|---|
| 400 | 146 | 0.58 | 50 | Lived |
| 600 | 190 | 1.14 | 50 | " |
| 800 | 119 | 0.95 | 60 | " |
| 1000 | 172 | 1.72 | 80 | " |
| 1200 | 93 | 1.12 | 65 | " |
| 1400 | 123 | 1.72 | 85 | " |

This chemical is apparently tolerated in very large doses, no disturbance being noted.

*Sodium Hydrosulfite.—Analysis of Commercial Samples.*

Some time ago a number of samples purchased as hydrosulfite were examined and it was found that some confusion exists concerning this substance. The products consisted in some cases of anhydrous $Na_2S_2O_4$, having a high reducing power on methylene blue, at room temperatures. Other products appeared to consist entirely of sodium formaldehyde sulfoxylate, exhibiting no reducing power under these conditions whilst still other samples had an intermediate reducing power. The last named were either deteriorated products or mixtures.

After studying several methods we finally adopted this method of Knecht and Hibbert[13] for routine work. For this purpose standard solutions of titanous chloride, and of methylene blue are prepared, the former being standardized against ferrous ammonium sulfate.

$$2\ Ti\ Cl_3 = 2\ H = 2\ Fe = Na_2S_2O_4 = C_{16}H_{18}N_3SCl$$
$$2 \times 154.5 = 2 \quad 112 \quad 174 \quad 373.75$$

An approximately one per cent. solution is prepared by diluting 50 cc. of the commercial 20% Ti $Cl_3$ solution with 50 cc. of conc. hydrochloric acid, boiling and diluting with air-free acidulated water to one liter. This solution is stored under special precautions under hydrogen.

For purposes of standardization 0.7 g. Mohr's salt is dissolved in 25 cc. diluted sulphuric acid, and titrated with a very slight excess of potassium permanganate solution. Into this solution is now run the titanous chloride solution until the ferric salt has been just reduced, using KSCV as an outside indicator.

This titanous chloride solution is only moderately stable. For instance, in one case we found 1 cc. $TiCl_3$ sol. = 0.006 g. Fe (January 10). Later (March 25) 1 cc. = 0.00565 g. Fe.

For the relative standardization 25 cc. of the mythelene blue solution is diluted with about 25 cc. air-free water, acidified with 5 cc. of 25 per cent. acetic acid. The titration is made in an Erlenmeyer flask fitted with a two-holed stopper, one of which is an inlet for a stream of carbon dioxide. We prepared the methylene blue solution so that it will be equivalent to the titanous chloride. It is perhaps advisable to permit a small amount of insoluble material to separate if necessary and to use the supernatent solution. This solution is stable, only an occasional comparison with the standard titanous chloride solution being necessary.

For the analysis of commercial hydrosulfites, since 1 cc. 1% $TiCl_3$ sol. = 0.003625 g. Fe = 0.005631 g. $Na_2S_2O_4$, we usually use for analysis 0.12-0.14 g. anhydrous hydrosulfite if we have 1% titanium chloride solution. This is placed in a dry Erlenmeyer, covered with 25 cc. (an excess) standard methylene

[13] B., 40, 3827 (1907). Knecht and Hibbert, "New Reduction Methods in Volumetric Analysis." Longmans, Green & Co., 1918.

blue solution, all the air is displaced with $CO_2$ and then the solution is acidified with 5 cc. of 25% acetic acid, and after standing at room temperature a short time the excess of methylene blue, which the $Na_2S_2O_4$ has failed to reduce, is titrated with the titanous chloride solution.

Example: 0.1648 g. sodium hydrosulfite + 24.8[11] cc. standard methylene blue solution, required for decolorization, 9.3 cc. $TiCl_3$ solution. (1 cc. $TiCl_3$ sol. = 0.00588 g. Fe = 0.009135 g. $Na_2S_2O_4$. In a duplicate assay 0.1584 g. required 10 cc. $TiCl_3$. Found, 85.9% and 85.3%.)

The following results were obtained upon commercial samples submitted as "hydrosulfite."

| Taken. | Found. | Per Cent. Purity. |
|---|---|---|
| 0.1200 | 0.1016 | 84.7 |
| 0.103 | 0.0809 | 78.5 |
| 0.104 | 0.0073 | 6.98 |
| 0.107 | 0.0082 | 7.17 |
| .102 | 0.0 | 0.0 |
| .103 | 0.0103 | 10.12 |
| .102 | 0.0828 | 81.2 |
| .103 | 0.0061 | 5.91 |

The samples showing low reduction contain formaldehyde and are used for vat indigo dyeing. These should not be listed as hydrosulfites. The reduction of methylene blue was materially increased by raising the temperature, indicating the presence of sodium formaldehyde sulfoxylate.

*Purification and Stability of Sodium Hydrosulfite.*—We endeavored to ascertain the possibility of increasing the reducing power *i. e.*, increasing the purity. Aqueous solutions are unstable. In order to determine the rate of deterioration, quantities of $Na_2 S_2O_4$ (85.3%) were weighed into a dry 20 cc. volumetric flask, covered with toluene, 1 cc. of 2N sodium hydroxide solution was added and the solution was brought to the final volume with air-free water. The solution was emptied into a small burette, which had been filled with carbon dioxide, and contained a layer of toluene. This solution was titrated against 10 cc. of a standardized acidified methylene blue solution in an atmosphere of carbon dioxide. 10 cc. methylene blue = 0.0453 g. $Na_2S_2O_4$.

[11] Twenty-five cc. of the solution = 24.8 cc. $TiCl_3$ solution.

| $Na_2S_2O_4$ (85.3%) Taken. | Volume. | Solution Used for 10 cc. M.B. | Time. | Loss % |
|---|---|---|---|---|
| 0.1036 | 20 | 10.5 | At once | —2.3 |
| 0.1050 | 20 | 10.16 | " | —2.6 |
| 0.1049 | 20 | 10.15 | " | —2.3 |
| 0.0707 | 20 | 15.07 | " | —0.3 |
| 0.1513 | 20 | 7.15 | " | —1.8 |
| 0.1026 | 20 | 10.7 | 10 min. | —3.2 |
| 0.1031 | 20 | 10.62 | 20 " | —.3.0 |
| 0.1177 | 20 | 9.6 | 6 hrs. | —6.0 |
| 0.1062 | 20 | 13.7 | 22½ " | —27 0 |
| 0.1064 | 20 | 16.75 | 16 " (no toluol) | —40 |

The above solutions were alkaline and a conspicuous breakdown is observed after 5 hours.[15] The protection of toluol is an important factor. All of the above titrations were made in acetic acid solutions. The titrations give the same results in neutral or alkaline media, but the solutions are turbid (errors —3.5 and 2.2%). Even when rapidly performed the results obtained fall below those obtained by using an excess of methylene blue solution by 2.5%. For rapid work the method is sufficiently accurate and the titanium chloride solution can be dispensed with. This method is like the original Bernsthen [16] method, using indigo carmine and is quite neat. Knecht & Hibbert point out that this method is not satisfactory for certain commercial samples, since they decompose with the evolution of $SO_2$ when dissolved in water; they claim furthermore that if alkali is added to preserve the solution that oxidation proceeds so rapidly that within a "few seconds" the results are vitiated As shown above, with careful work the error approximates = 2.5%.

We attempted to purify commercial sampies of hydrosulfite as follows: 50 g. high grade hydrosulfite was poured upon 125 cc. air-free water, containing a few cubic centimeters of sodium hydroxide solution at 70° in a current of carbon dioxide or under toluene. The solution was filtered through asbestos in a closed system under carbon dioxide and the filtrate cooled in an ice bath under an inert gas. After crystallization was complete (1 hour), the crystalline hydrosulfite was filtered in a closed system, and mixed upon the alundum

[15] See Lumiere, Lumiere & Seyewetz, *Bull. Soc. Chim. 33*, 931 (1905).

[16] Bernsthen & Drews, B. 13, 2283 (1880), Schützenberger & Risler, *Bull. Soc. Chim.* 19, 152 (1873).

filter with absolute alcohol. The suspension was transferred to a flask containing 300 cc. of alcohol and sodium (15 g.) ethylate, or methylate with mechanical stirring. The dehydrated product was filtered in a closed system and washed [17] with alcohol and ether. The funnel was transferred to a desiccator containing carbon dioxide and dried in vacuo over phosphorous pentoxide. The highest purity obtained was 83.5 per cent., so that practically nothing was gained, although some insoluble sludge is removed by filtering solutions of the commercial product.

This experiment is difficult to manipulate, and even if the preliminary work is successfully conducted, high-grade recrystallized products are prone to decompose upon opening the desiccator. One sample which had been dried for two weeks at 15 to 20 mm., and which assayed over 75 per cent., burst into flame while a sample was being assayed. Some samples showed a tendency to warm up, and were returned to a vacuum in various stages of decomposition.

The ease with which this decomposition proceeds was amply demonstrated in the above-mentioned series of experiments, many of which miscarried. This difficulty certainly justifies the many efforts toward this goal, which are found in the patent literature. D. R. P. 267,872 [18] (1912) directs the mixing of the hydrosulfite with an excess of aniline and evaporation in a vacuum to dryness, with uninterrupted stirring. The object of this procedure is to avoid filtration of the crystalline salt, but the product must of course be impure. In subseqent patents the conditions of the distillation are altered.[19] In other patents [20] evaporations are conducted with alcohol, xylol, hydrocarbons, ammonia, and alkalin substances.

In D. R. P. 280,181, zinc hydrosulfite is mixed with dried sodium acetate, and the mixture is extracted with 94-96 per cent. alcohol, which dissolves the zinc and sodium acetates and leaves a residue of anhydrous sodium hydrosulfite.

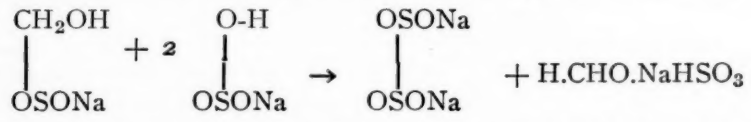
Bazlen in his paper on the composition of hydrosulphurous acid, points out the ease with which these alkali salts oxidize, and also how readily thiosulfate is formed even in the absence of air, and he states that drying in a vacuum at ordinary temperature or at more elevated ones in the absence of air leads to decomposition. His method for dehydration consists in placing an alcoholic magma in a Soxhlet and extracting for several hours, using lime in the receiver.[21] He reports an analysis on the pure salt, $Na_2S_2O_4$.

It was with these patents in mind that we attempted the above purification, but the results were such that we were led to attempt purification and preparation through the use of another principle, *i. e.*, salting out the anhydrous form. The temperature above which

[17] U. S. P. 987,170.
[18] U. S. P. 1,156,107 (1915).
[19] D. R. P. 279,389; U. S. P. 1,207,782 (1916).
[20] D. R. P. 213,586, 188,139, 223,260, 207,593; U. S. P. 861,218.
[21] D. R. P. 160,529 (1904).

the anhydrous form cannot exist is 52°. According to D. R. P. 171,991 (1905), one saturates a concentrated solution of sodium hydrosulfite (50-70°) with sodium chloride, or one may warm crystalline sodium hydrosulfite at 50-70° under saturated brine. Thus 2000 volumes concentrated hydrosulfite solution is heated to 50-70° and 510 parts of salt are added with stirring. When the characteristic separation of the anhydrous form is complete, it is filtered in a closed system, using $CO_2$, washed with alcohol and dried in a vacuum over sulfuric acid. This method is very satisfactory on the laboratory scale, but it does not essentially raise the purity of the commercial material, although the patent claims that 100% material results. This probably depends upon the nature of the impurity in the original material.

*Preparation of Sodium Hydrosulfite on Laboratory Scale.*—In our last effort to secure analytically pure, anhydrous hydrosulfite we attempted to avoid the impurities originally present in the hydrosulfites, by preparing it from analytically pure sodium formaldehyde sulfoxylate. Bazlen proved that hydrosulfite can be prepared by the interaction of sodium formaldehyde sulfoxylate and sodium bisulfite. He permitted the crystalline form to separate. U. S. P.




990,457 (1911) combines the principles of this reaction with that of the salting out process as follows: 420 cc. of bisulfite solution containing 208 g. $NaHSO_3$, containing no free sulfurous acid are heated to 60°; 140 g. salt are introduced and the temperature raised to about 65°. In a second vessel a concentrated solution of 118 g. sodium formaldehyde sulfoxylate (230 cc.) is heated to 65°. The contents of both vessels are mixed as rapidly as possible. There is a rise of about 8° and a heavy precipitate of anhydrous hydrosulfite separates. We filtered this off in a closed system under $CO_2$ washed with alcohol, ether, and immediately placed the product in a $CO_2$ desiccator and dried at 15-20 mm. The purity claimed for this product, *i. e.*, "an amount of the salt containing one gram of sulfur reduces 4 g. of indigo" is equivalent to a 97.7% purity.

Our yields on small scale experiments in the quantities above outlined give yields of 55 to 60% of theory, and a purity of 80-85%. The product is stable when kept in tightly stoppered containers. Larger scale production would probably result in higher purity.

*Toxicity of Sodium Hydrosulfite.*—The failure to obtain products by the above process having a purity of at least 95% is a matter of considerable surprise. In the presence of air the damp salt oxidizes as follows:

$$Na_2S_2O_4 + O \rightarrow Na_2S_2O_5 \rightarrow Na_2SO_3 + SO_2$$
$$Na_2S_2O_4 + O + H_2O \rightarrow 2\ NaHSO_3$$

In the absence of air it is said to decompose forming pyrosulfurous and thiosulfuric acids. We have never observed any con-

$$2\ Na_2S_2O_4 \rightarrow Na_2S_2O_3 + Na_2S_2O_5$$

spicuous alteration in well made samples. It is however a fact that the oxidation products of the dry substance are quite as toxic as the hydrosulfite itself.

The following results were obtained: A preparation having a purity of about 83% was dissolved in water and quantities amounting to 150, 180, 210 mg. per kilo proved not fatal, and no effects were observed. With a dose of 240 mg. per kilo death ensued in five minutes.

A second sample having approximately the same purity (83.5%) gave the following results: The rats lived at doses of 100 and 125 mg. per kilo, but at 150 mg. per kilo, death ensued in 7 minutes.

A few similar tests were made upon some of the partially decomposed samples that were obtained when it was attempted to dehydrate the crystalline product with sodium ethylate. The toxicity is not proportional to its reducing activity as is shown by the following results. A badly decomposed sample, analyzing 28% failed to kill in doses of 50, 100 and 150 mg. per kilo, but at 200 mg. per kilo death took place in four minutes, and 10 minutes respectively. This sample is almost as toxic as the above mentioned 83% material.

A sample which had run down to 65% in the desiccator over $P_2O_5$, suddenly evolved clouds of $SO_2$ when the desiccator was opened. The analysis showed only 14% (reducing power). When this was injected the rats lived at 200, 300, 325 mg. per kilo, but were killed at 350 mg. (4 minutes).

From the above tests it will be observed that the dry decomposition does not proceed simply from a toxic to a nontoxic substance, nor, is the physiological test, a method for determining the degree of decomposition.

Small doses (25-50 mgs. per kilo) of sodium hydrosulfite injected intravenously into white rats produce no reaction. As the dose (100 mgs. per kilo) is increased the rat shows signs of labored breathing within a few seconds of the beginning of the injection. This quickly wears off and usually within five or ten minutes the rat is apparently normal. Still higher doses (150 mgs. per kilo) produce a more labored breathing with evidence of suffocation. When the maximum sub-lethal dose is reached the rat shows symptoms immediately. Dyspnea becomes acute and the rat doubles up with convulsions within three to five minutes. After eight or ten minutes it has completely recovered and moves about normally. There are no delayed symptoms in rats which survive the injection. The toxic dose produces the same immediate symptoms which rapidly progress in intenisty until death which usually occurs within five to ten minutes.

We wish to acknowledge the biological assistance of Mr. Payne.

CONTRIBUTION FROM THE CHEMICAL RESEARCH LABORATORY,
THE UPJOHN COMPANY, Kalamazoo, Mich.

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## THE EVOLUTION OF CHEMICAL TERMINOLOGY.
## I. COAGULATION.

By JAMES F. COUCH.

In attempting to define with exactness many of the terms in common use at the present time it is often found that there is considerable latitude of meaning covered by the word or phrase. In many cases the limits set about the proper application of a term are vague and may permit its usage in contradictory senses. Such indefiniteness, foreign to the modern scientific spirit, leads often to indiscriminate use of the term and clutters up the literature with much that is sloppy and too much that is not only misleading but positively erroneous. Unfortunately a great deal of this vagueness cannot be remedied as yet for it proceeds from an insufficient knowl-

edge of the phenomena with which the term is associated or results from the applying of the term to a broad field which contains within itself confusing and contradictory elements.

In other cases it happens that a term still in common use was applied generations ago to some type of phenomena which were imperfectly understood. With this as a foundation newly discovered facts were classified by more or less empirical methods according to analogy until the term is now made to represent things which in principle are widely different. Again, because of a lack of knowledge of the mechanism of natural processes two facts which depend essentially on the same fundamental generality have been classified under different names because of some superficial difference in nature.

Another and a fruitful cause of confusion has been the use of specific terms in literature where the exigencies of rhetoric, of the avoidance of repetition, and the difficulties of conveying ideas, not to mention the foot-rule of versification, outweigh considerations of narrow exactitude in the choice of words. We read, for instance, that a large population was coagulated in London; we might, with equal propriety, refer today to the "gelated traffic" at our busy street crossings.

It is possible, however, to remedy a large part of the existing indefiniteness in the use of chemical terms; indeed, it is a simple matter. It requires only an agreement among those who employ the terms to limit certain expressions to certain specific meanings. With this very desirable end in view I purpose to consider in this, and in other communications which are in course of preparation, a number of loosely defined terms, to discuss the manner in which they are now used, to present any objections to this usage, and finally to propose whatever action appears to me best to eliminate the undesirable features.

What is coagulation? In referring to such authorities as the writers of text books, particularly those that deal with physiological and colloid chemistry, we find that while frequent mention of the process of coagulation is made and while it is often exhaustively discussed, the authors studiously avoid defining the term. One must dissect and analyze the whole matter presented by the author before his idea of the process may be determined. We turn then to the standard dictionaries of our language.

Webster's [1] presents this definition: "Coagulate [2] . . . To effect the coagulation of; curdle; clot; congeal; . . . ."

James A. H. Murray [3] defines "coagulate" thus: "1. To convert (certain fluids, as blood, milk, albumen, etc.) into a soft solid mass, as by chemical action, heat, exposure to air, etc.; to curdle, clot, congeal. 2. To form (anything plastic) into a solidified cake or mass; to form as a mass."

Funk and Wagnall's [4] says: "Coagulate . . . To change (a liquid, as blood or milk) into a clot or a jelly, as by heat, by chemical action, or by a ferment; curdle; congeal."

The Century [5] defines "coagulate" as follows: "To curdle; congeal; clot; change from a fluid into a curd-like or thickened mass . . . ."

Gould [6] defines "coagulation" as "The formation of a coagulum or clot" and Dorland [7] as "1. The process of changing into a clot or of being changed into a clot. 2. A clot."

Wo. Ostwald [8] offers this: "Unter Koagulationsvorgängen disperser, im speziellen kolloider Systeme verstehen wir weitgehende Veringerungen des Dispersitätsgrades der dispersen Phase, verbunden mit einem Aufgeben der Homogenität der räumlichen Verteilung."

The generally accepted idea of the term coagulation then is this: It is a process which results in the separation from a liquid system of a non-rigid solid mass or the conversion of a liquid into such a mass. This definition is faulty in that it is too inclusive; it

[1] *New International Dictionary of the English Language*, 1919, p. 424.

[2] In some dictionaries the definition is given under the word "coagulation," in others it is given under "coagulate," and the derivative terms are referred to the form defined. I shall here make no distinction in quoting the lexicographers.

[3] *A New English Dictionary on Historical Principles*, 1898, Vol. 2, p. 548.

[4] *New Standard Dictionary of the English Language*, 1913, p. 508.

[5] *The Century Dictionary and Cyclopedia*, Vol. 2, p. 1067, 1911.

[6] *An Illustrated Dictionary of Medicine, Biology and Allied Sciences*, p. 305.

[7] *The American Illustrated Medical Dictionary*, 1916, p. 230.

[8] *Grundriss der Kolloidchemie*, 1910, p. 446. This definition may be freely translated: "By the process of coagulation of substances dispersed in colloidal systems we understand a far-reaching diminution of the degree of dispersity of the disperse phase accompanied by a giving up of the homogeneity of spatial distribution."

must be modified to distinguish between coagulation and such processes as flocculation, gelation, precipitation, congellation.

In the first place coagulation is a colloidal phenomenon. Albumen solutions, blood, milk, the latex of Ficus elastica, are all colloidal systems. By limiting coagulation to colloids we remove from consideration many similar phenomena which may, under appropriate conditions, occur in true solutions. The precipitation of aluminium hydroxide by ammonia may give rise to a semi-solid mass which superficially resembles a coagulum. A characteristic of coagulation which readily distinguishes it from the process of gelation is that it involves a separation of the disperse from the continuous phase of the colloidal solution: in gelation there is no such complete and sharp separation although it is true that the gel may lose its sorbed solvent by evaporation, in the course of time.

When we consider the question of the reversibility of coagulation processes, however, we discover no general agreement. While the common instances of coagulation (in albumen solutions, blood-clotting, etc.) are clearly irreversible there is a large number of instances which are, by some authors, included in the general class of coagulations and which are known to be reversible. Bechhold [9] considers coagulation as irreversible but prefers to use the term "flocculation" for most colloidal separations. Analysis of his discussion of these phenomena leads to the following conclusion: Flocculation is an electrical phenomenon; it is irreversible; it consists in the precipitation of hydrophobe colloids by electrolytes. The system, therefore, cannot be flocculated unless it contains an hydrophobe colloid. He distinguishes reversible separations of dispersed phases and their continuous phases by the term "salting out." Bancroft,[10] on the contrary, uses the term coagulation in the broader sense; *e. g.*, he says (p. 221), "When albumin is precipitated by sodium chloride, the coagulation is ordinarily reversible. When it is precipitated by the salt of a heavy metal, the coagulation is irreversible." Consequently there is no agreement as to the reversibility of coagulation; each author determines this question by the extensiveness of his application of the term.

Without attempting to analyze the whole mass of accumulated

[9] "Colloids in Biology and Medicine." Trans. J. G. M. Bullowa, 1919, p. 82.

[10] "Applied Colloid Chemistry," 1921, p. 212, *et seq.*

data it may be said that there are three general methods by which the separation of the phases in a colloidal system may be effected: 1. By alteration of the chemical nature of the disperse phase; 2. by altering the physical structure of the disperse phase; and 3. by altering the electrical equilibrium of the system or of the disperse phase. These are three very distinct processes and depend upon widely different mechanisms. Almost the only similarity is to be found in the end result and even here great differences occur. We know that in the heat-coagulation of albumins there is definite chemical alteration of the molecule; in the clotting process of blood a new substance, fibrin, which is not a factor of the initial system appears, formed from one of the constituents of the normal blood. Neither of these processes is reversible. In the curdling of milk, however, which is the third common instance of coagulation, the case is different. In the souring of milk or following the addition of rennin, the casein separates from the liquid mixture. Note that the curdling which follows souring,—or the increase of hydrogen ion concentration,—is a true precipitation for it is due to the decomposition of calcium caseinate with the liberation of insoluble casein and is strictly analogous to the precipitation of salicylic acid from an aqueous solution of sodium salicylate upon the addition of a stronger acid. It is not true coagulation. The action of rennin, on the contrary, produces curdling by altering the casein and the process is not reversible. Consequently, in all three cases of coagulation which are common phenomena and from which our ideas of coagulation are primarily drawn, we have instances of irreversible changes.

Coagulation may be readily distinguished from congelation as the latter term includes any solidification without regard to its nature or the mechanism by which it is produced. The "setting" of wet plaster of Paris or of concrete mixtures are congelations. In the term precipitate we have a general name which includes all instances in which a solid or semi-solid substance, either in an integral mass or in a finely divided state, separates from a liquid. Coagulation is therefore a special case of precipitation. Flocculation may be considered a process in which the degree of dispersity of a colloid in suspension is diminished although this term itself is not narrowly defined and has been used in different senses.

Enough evidence has now been presented, I think, to show the necessity for the adoption of a convention in order to define these

terms satisfactorily. We are forced arbitrarily to exclude certain ideas now associated with the terms and to restrict the assigned meanings to limits which will sharply distinguish the different terms. It is therefore recommended that coagulation be defined:

> An irreversible process of colloid chemistry; it consists of the complete or partial separation of the disperse from the continuous phase as the result of the chemical alteration of the system. The altered disperse phase is precipitated as a non-rigid, insoluble, solid mass.

and that flocculation be considered:

> A process of colloid chemistry in which the complete or partial separation of the phases is effected through an alteration of the physical condition of the disperse phase, either by a diminishing of its degree of dispersion or by a modifying of the electrical equilibrium of the system.

The analysis suggests the usefulness of two new terms; collyte, a name for any disperse phase, and collysis, a general term to indicate any separation of the two (or more) phases in a colloidal solution.

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## COMMERCIAL GLUCOSE AS A PREVENTIVE OF AUTOMOBILE RADIATOR FREEZING.

By CHARLES H. LAWALL.

The drug, chemical and trade journals frequently contain articles giving formulas for anti-freezing mixtures for automobile radiators. These formulas usually contain denatured, or wood, alcohol, glycerin, or some chemical salt such as calcium chloride.

For four winters past I have successfully employed commercial glucose with unquestioned efficacy and with no detrimental results whatever. The ordinary confectioners' white glucose is preferred, although I have on one occasion employed the glucose sold for table use.

The amount necessary is between 15 and 20 per cent. or about a pint and a half of glucose to a gallon of water. The glucose may be mixed with enough warm water to completely dissolve it and then added to the remainder of the water in the radiator. No further addition or attention is necessary except to replace the water lost by evaporation. When warm weather arrives the radiator should be emptied, rinsed out and filled up with plain water.

In addition to using the mixture practically for four years with satisfactory results I also performed some experiments to determine the congealing point of such a mixture. I found that it begins to get slushy at about 10° above zero F., but that it does not actually freeze and harden even at 6° below zero F.

Glucose does not corrode nor affect metals; in fact, it prevents such action by virtue of its chemical reducing properties. It seems to have no effect upon rubber in the dilution used; at least, I have never had to replace my rubber hose connections. There are no objections to glucose at all that I have found and its inexpensiveness and the freedom from the annoyance of constantly having to replace a volatile solvent such as alcohol, are unquestioned advantages.

DEPARTMENT OF THEORETICAL PHARMACY, PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE.

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## A REPORT ON THE ZAMIA STARCH SITUATION.*

By JOSEPH F. CLEVENGER.

One region in Florida where the Zamia plant, *Zamia floridana* DC., grows was visited, and a number of the plants were dug up and examined. In addition, the only mill manufacturing starch from the plant was visited. The following information was collected:

*Description of Plant.*—Zamia is a small dicœcious plant, with a crown of leaves producing on different individuals pistillate (Pl. I, A) and staminate (Pl. I, B) strobili (cones). This is characteristic of the Cycadaceæ to which family the plant belongs. The seeds (Pl. I, D), which are developed in the pistillate strobili, are somewhat oval, measuring approximately one-half inch in length. The cross section shows a triangular outline, a relatively thin, hard seed coat, and a starchy endosperm. When the seeds are mature the pistillate strobili disintegrate and the seeds may frequently be observed in large numbers near the base of the crown of leaves. The plant has an enlarged tuberous-like stem (rhizome) which grows below the level of the ground. This habit of the plant enables it to withstand the frequent fires to which the region where

*Presented at the Sixty-ninth Annual Meeting of the American Pharmaceutical Association, New Orleans, La., September 6-11, 1921.

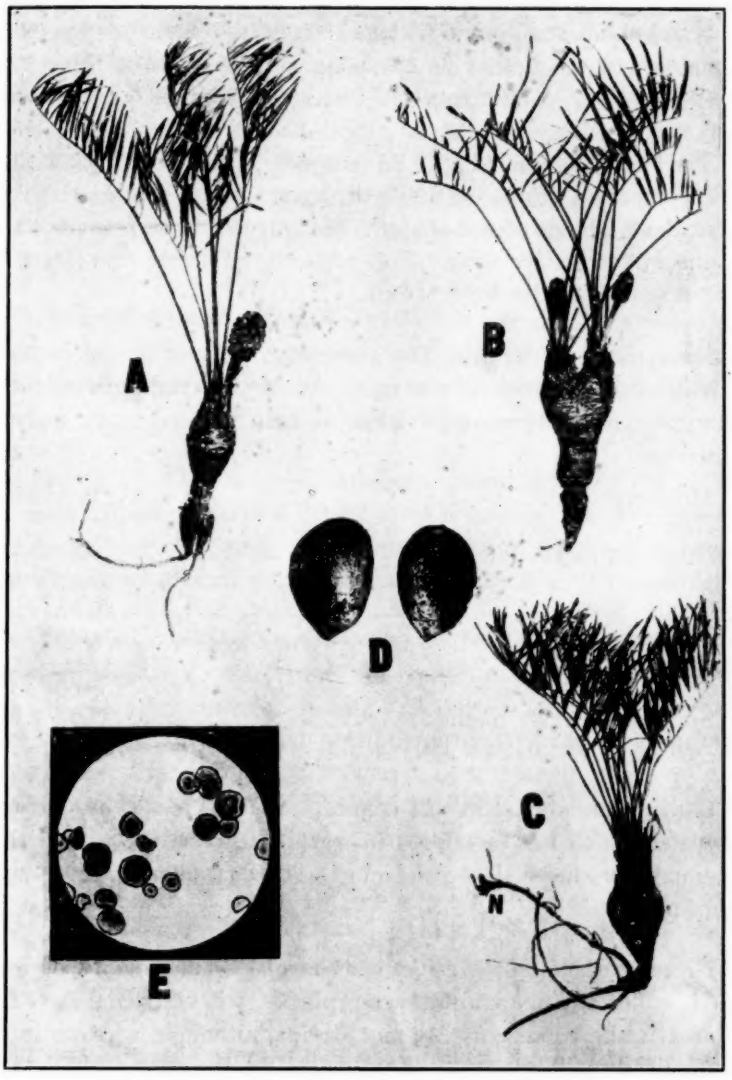


PLATE 1—ZAMIA FLORIDANA DC.

A. Female plant showing tuberous-like rhizomes, crown of leaves and a pistilate strobilus (cone). Approximately X ⅛.
B. Plant showing staminate strobili (cones). Approximately X ⅛.
C. Plant showing root tubercles. N. Approximately X ⅛.
D. Seed. Approximately natural size.
E. Starch grains. Approximately X 140.

it grows is subjected. It is of interest that numerous root tubercles, presumably collecting nitrogen from the atmosphere, as do the nodules of the Leguminoseæ, occur on the roots of this plant.[1] (See Pl. I, Cn.) These tuberous-like stems contain large amounts of starch.

The starch grains (Pl. I, E) are simple, with the exception of a few compound grains of few components. The single grains are spherical ovoid and dome-shaped, and vary in size from 6 to 40 microns in the longer axis. The majority of them vary from 16 to 32 microns in the longer axis.

*Analysis of Rhizome.*—The following analysis of the plant on an air-dried basis, made in the Cattle Food and Grain Investigation Laboratory, Miscellaneous Division, Bureau of Chemistry, may be of interest:

| | |
|---|---|
| Moisture | 7.73% |
| Ash | 5.01% |
| Ether extract | 0.63% |
| Protein (N x 6.25) | 6.17% |
| Crude fiber | 9.23% |
| Nitrogen-free extraction | 71.23% |
| | 100.00% |
| Starch (diastase method) | 37.75% |
| Ash insoluble in 10% HCl | 0.90% |

Of further interest in this connection is the report by Gifford[2] that water which has been used in washing the starch, when drunk by animals, produces slow poisoning. The character of this poison is not known.

*Growing Region of the Plant in Florida.*—The region where the plant is collected for manufacturing purposes is restricted to a limited area in the vicinity of Miami, Florida, although it grows in the pine lands throughout the southern part of the state.[3] This area

[1] Karl F. Kellerman, "Nitrogen-gathering Plants." *U. S. Department of Agriculture Yearbook*, 1910, pp. 213-218.

[2] John Gifford, "The Everglades and Southern Florida," 2d Ed., 1912, p. 173.

[3] Winifred Kimball, "Reminiscences of Alvan Wentworth Chapman." *J. New York Botanical Garden*, 22, 13, 1921.

does not extend appreciably south of Miami and not much north of Dania, nor in the regions which are subject to overflow. The total area in which this form grows may be roughly estimated to cover about 150 square miles. The area, however, in which the plant may be profitably collected is rapidly diminishing on account of the rapid growth of the city of Miami and its suburbs. The occurrence of a closely related form farther north in the central part of the state is reported, but it does not appear to be used as a source of starch.

*Cultivation of the Plant.*—Zamia has not been cultivated on a commercial scale. Attempts made in California to grow this plant from the seed were apparently unsuccessful, possibly due to the absence in the soil of the organisms forming the tubercles.

*Supply of Rhizomes.*—The manufacturer depends for his supply chiefly upon collections by the local residents, who are employed to dig up these rhizomes. It is stated that the same region may be profitably worked over once each five years.

*Preparation of the Starch.*—The method used in preparing this starch is similar to that used for other starches. The undried rhizome, when ground and mixed with water, is passed over a fine screen to separate the main portion of the vegetable tissues from the starch. The product is then run into settling tanks, where a further separation is obtained. After the starch has settled it is drawn off and dried. The whole operation requires approximately three days.

*Use of the Starch.*—The starch (Pl. I, E) is used by natives as a food, and, in limited amounts in making crackers, biscuits, and other food products requiring starch.

*Present Status of the Industry.*—While the mill under normal conditions is reported to have a capacity of about 24,000 pounds per week, or about 750,000 pounds per year, it has been idle since September, 1920.* It is uncertain when this mill will be in operation again. The manager contemplates, when circumstances per-

*Mill visited on January 15, 1921.

mit, to manufacture starch from Zamia rhizomes and also to ship Maranta roots from the West Indies with the idea of preparing starch from them.

Analytical data, such as the tincture power of different reagents, optical properties, and temperature of gelatinization, determined by Reichert [4] for both Maranta and Zamia starch, have been partly checked by the writer. Although useful as a means for differentiation, these data have little or no value as a means to determine the relative value of the starches. The author has been unable to find any definite information regarding the value of Zamia starch as compared with other starches. It is claimed by the manufacturer, as indicated on the label of the carton of his package product, that "you do not get that starchy taste by using Florida Arrowroot."

*Designation of the Product.*—Zamia starch has been marketed under the designation "Florida Arrowroot." True arrowroot starch is obtained from Maranta root. This double use of the term arrowroot has led to confusion in the trade, which will become greater if Maranta starch is manufactured in Florida, as now seems possible. It is of interest that *Maranta arundinacea,* the plant yielding the product generally referred to as arrowroot starch, is cultivated to a limited extent in some localities in southern Florida.

The names "Koonti," "Coontie," or "Comptie," used by the Seminoles, refer not only to the Zamia plant and its products, but have the general significance of the word "bread," "grits," or "grub." [5] Since differences in the spelling as well as in the pronunciation of these terms also occur, it is evident that none of them would be a well chosen name. The names "Florida arrowroot starch" or "Florida arrowroot flour" should not be used for the reasons already given. The designation "flour" is distinctly objectionable, since during the process of manufacture tissue elements are practically eliminated.

In conclusion, the specific name Zamia starch should be applied only to the product obtained from Zamia plants.

[4] E. T. Reichert, "Differentiation and Specificity of Starches in Relation to Genera, etc." 1913.

[5] Clay MacCauley, "Seminole Indians of Florida," Fifth Annual Report Bureau of Ethnology, 1883-1884, p. 513. Gifford (*loc. cit.*), p. 170.

NOTE: After completion of the manuscript, an article by J. K. Small appeared in the *Journal of the New York Botanical Garden*, Vol. 22, pages 121 to 137, 1921. It is entitled "Seminole Bread.—The conti; a History of the Genus Zamia in Florida." The reader will find here interesting additional information on the subject of Zamia and its products.

PHARMACOGNOSY LABORATORY.
BUREAU OF CHEMISTRY.
U. S. DEPT. AGRICULTURE.

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## THE TENTH REVISION OF THE UNITED STATES PHARMACOPŒIA.*

By E. FULLERTON COOK, *Chairman.*

I am indebted to the officers of this representative association of pharmacists for the opportunity to present a review of the current Pharmacopœial revision, well knowing that to speak before the New York branch means to secure a national audience.

I also welcome the opportunity at this time to obtain the reaction when important decisions of the committee are made public.

The Pharmacopœia is not established to further the interest of any individual or group, but to do its part to maintain the public health through the activities of the medical and pharmaceutical professions. Its standards should receive the approval of enlightened public opinion when expressed by those qualified to judge.

Therefore a public forum, where there are gathered those who are struggling against disease, is a fitting place to announce and discuss proposed scope and standards.

There are of necessity limitations to the publicity concerning committee work, since it would be manifestly unfair to predict the decision on questions which are yet under discussion but, where conclusions have been reached, the policy of the revision calls for public announcement and comment.

*Read before the New York Branch of the American Pharmaceutical Association, November, 1921.

*Organization.*—The organization of the committee is so well known through various articles published in recent years, that little need be said of this.

The *General Committee,* made up of all regularly elected members, is the group by which questions of policy and general principles are discussed and decided. For the detailed, scientific study and revision of texts the *Sub-committee Groups* have been organized and here the specialists have full opportunity to use their training and experience that the new text may express the last scientific fact and the accepted standards and tests.

A new feature of the Tenth Revision has been the addition of *auxiliary members* to sub-committees in an advisory capacity. The Committee of Revision and Board of Trustees approved a recommendation that sub-committee chairmen be permitted to nominate auxiliary members for their sub-committees, the nominations to be subject to the approval of the General Committee and Board. It was pointed out that in this way the active help of many specialists through experimentation and comment would be secured for the revision and also new pharmacopœial workers developed, but it has always been definitely understood and accepted by all proposed auxiliary members that the voting power remains exclusively under the control of the regular committee members.

More than seventy auxiliary members have been nominated and approved and many are rendering valuable assistance on sub-committees.

The chairmen of the fifteen sub-committees constitute the *Executive Committee.* This committee is made directly responsible in the by-laws for the revision, but their greatest activity is as individual chairmen of the special groups constituting their sub-committee.

The Executive Committee, however, is called upon to decide questions of a scientific character and aid by discussion and suggestion in the preparation of texts.

To facilitate the filing of communications in the various groups the "Circulars" of the General Committee are mimeographed on white paper, the letters for the Executive Committee on yellow paper, and all sub-committee "Bulletins" on blue paper. All paper is punched for insertion in binders, and individual binders supplied for each set. Whenever a voting sheet

is issued, or a communication to be returned, it is issued in duplicate and on salmon-colored paper and accompanied by a stamped, addressed return envelope.

This has proven gratifyingly effective in securing votes and other responses from the committee, and usually more than 80 per cent. of the members respond within the time limit.

*Co-operation.*—The current revision has been receiving co-operation of the most valuable character from every affiliated interest. Medical associations and individual physicians have responded to requests to help in the settlement of the therapeutic questions, the several departments of the Government, whenever called upon, have responded promptly and the Bureau of Chemistry have organized a committee of experts within the Bureau to study and help every department of the revision. Many valuable suggestions come from the papers presented at the meetings of the A. Ph. A., American Drug Manufacturing Association, Association of Official Agricultural Chemists and various State and other drug associations. Individual pharmaceutical manufacturers and colleges of pharmacy have also been aiding the revision and a special service rendered by colleges of pharmacy has been the abstracting of texts from foreign pharmacopœias for the use of sub-committee chairmen.

*Scope.*—Early in the revision it was agreed that the decision concerning admissions and deletions for the Tenth Revision would be placed in the hands of the Sub-committee on Scope. This is a representative committee of physicians and pharmacists, and it has earnestly endeavored to advance the true value of the Pharmacopœia by restricting admissions to remedial agents which possess undisputed therapeutic value or are pharmaceutic necessities. The labors of this sub-committee are not yet completed and their decisions are subject to reconsideration by a special committee, but work has advanced far enough for a public announcement to be of interest. A number of titles, about two hundred, including chiefly galenical preparations which were left until last, have not yet been reported upon to the General Committee, but are all under discussion in the sub-committee. Four hundred and seventy-five (475) articles, formerly official, have definitely been admitted to the U. S. P. X.

The following new articles, twenty-seven in number, have been recommended for the U. S. P. X., it being understood that several in the list may not be finally admitted because of legal or other complications:

Acetyl-Salicylic Acid
Acetyl-Tannin (Tannigen)
Carbromal
Adrenalin
Solution of Adrenalin Chloride
Albumen Tannate
Argyrol
Arsphenamine
Neo-arsphenamine
Barbital
Barbital-Sodium
Barium Sulphate
Benzyl Benzoate
A 20% preparation of Benzyl Benzoate
Dichloramine-T
Phenobarbital
Oleum Chaulmoograe
Procaine Hydrochloride
Protargol
Sodium Diphosphate ($NaH_2PO_4$)
Dextrose (Chemically pure)
Anesthesin
Dakin's Sôlution
Chloramine-T
Sajodin or similar type
Pyramidon
Chlorinated Paraffin (for Dichloramine-T)

Referring to trade-marked or patented chemicals proposed for admission, it is gratifying to announce that the Winthrop Chemical Company, Incorporated, which controls several of these, have assured the chairman that they should be pleased at their inclusion in the Pharmacopœia, under appropriate conditions.

The conditions suggested are the use of descriptive chemical names, omitting the trade-marked titles.

For instance, "Luminal," if admitted, might be called "Phenobarbital" with the synonym "Phenylethylmanolylurea." The title of "Adalin" might be "Carbromal" and the synonym "Bromdiethyl-acetylcarbamide," and for "Veronal," the title "Barbital," with the synonym "Diethylbarbituric Acid." The descriptive titles *"Phenobarbital," "Carbromal"* and *"Barbital"* were all dedicated to the public use during the war and might properly find their place in the Pharmacopœia.

Where this policy is followed, the owners of trade-marks would use them as an indication of their special brand, and thus retain valuable rights, while other manufacturers who secure

licenses to make the product would likely adopt a special name, but would also use the Pharmacopœial title. This policy, where accepted by chemical firms, is much broader and more liberal than that usually taken and will no doubt be heartily approved by the medical and pharmaceutical professions.

The chemical foundation now controlling the licenses for a number of the manufacturing processes seized during the war, under the Enemy Trade Division of the Federal Trade Commission, has also expressed the opinion that there was no objection to the use in the Pharmacopœia of such titles as Arsphenamine and Neo-arsphenamine; also Barbital, Procaine and Cinchophen.

It will probably be desirable to include in the U. S. P. introductory notices a statement to the effect that since existing patents are involved in the manufacture of certain official products (listing these) a license from the owner of the patent is required for their manufacture.

The Sub-committee on Scope recommends that the following articles official in the U. S. P. IX. be not admitted to the U. S. P. *X.*:

Acidum Gallicum
Acidum Hydrobromicum Dilutum
Acidum Hydrocyanicum Dilutum
Acidum Hypophosphorosum Dilutum
Acidum Nitrohydrochloricum
Acidum Nitrohydrochloricum Dilutum
Aethylis Carbamas
Alumini Hydroxidum
Ammonii Iodidum
Ammonii Salicylas
Ammonii Valeras
Amygdala Dulcis
Anisum
Aqua Rosae
Aqua Aurantii Florum
Argenti Oxidum
Arnica
Aspidosperma
Auri et Sodii Chloridum.
Bismuthi Betanaphtholas
Bismuthi et Ammonii Citras
Bismuthi Subsalicylas
Bromoformum
Caffeina Citrata
Caffeina Citrata Effervescens
Calcii Glycerophosphas
Calcii Hypophosphis
Calcii Sulphidum Crudum
Camphora Monobromata
Cerii Oxalas
Chondrus
Cimificuga
Cinchoninæ Sulphas
Copaiba

Coriandrum
Diacetylmorphina
Diacetylmorphinæ Hydrochloridum
Diastasum
Ferri et Quininæ Citras
Fluidextractum Sarsaparillæ Compositum
Foeniculum
Frangula
Guaiacum
Guarana
Humulus
Hydrargyri Oxidum Rubrum
Hydrastina
Hydrastininæ Hydrochloridum
Lactucarium
Liquor Sodii Arsenatis
Lithii Bromidum
Lithii Carbonas
Lithii Citras
Maltum
Mangani Dioxidum Praecipitatum
Matricaria
Mezereum
Morphina
Moschus
Oleoresina Petroselini
Oleoresina Pinaris
Oleoresina Zingiberis
Oleum Cubebæ
Oleum Pimentæ
Oleum Thymi
Petroselinum
Physostigma
Pilocarpus
Piper
Potasii Hypophosphis
Pyrethrum
Quininæ Salicylas
Sabal
Sanguinaria
Sarsaparilla
Sassafras
Sinapis Alba
Sodii Arsenas
Sodii Arsenas Exsiccatus
Sodii Glycerophosphas
Sodii Hypophosphis
Sodii Perboras
Sodii Phenolsulphonas
Sparteinæ Sulphas
Spigelia
Staphisagria
Strontii Bromidum
Strontii Iodidum
Strychnina
Sumbul
Syrupus Calcii Lactophosphatis
Syrupus Hypophosphitum
Syrupus Sarsaparillæ Compositus
Taraxacum
Triticum
Uranii Nitras
Veratrina
Viburnum Prunifolium
Xanthoxylum
Zinci Carbonas Præcipitatus
Zinci Phenolsulphonas
Zinci Valeras

*Metric Abbreviations.*—The Committee of Revision adopted at its first meeting the abbreviation "cc" to replace "mil" for

liquid metric measure. The bureau of standards would prefer the abbreviation "ml" but object, with many others, to "mil" and prefer the adopted abbreviation "cc" if the committee will not accept "ml."

The spelling "gram" has also been adopted to replace the former "gramme," but the old abbreviation "Gm." had been retained. There has been some criticism in the committee of the evident discrepancy in these abbreviations, the "cc" being neither capitalized nor written with a period, the "Gm." being both capitalized and followed by a period. The Bureau of Standards have adopted the letter "g" without period or capitalization as the abbreviation for "gram," but this is obviously unfit for Pharmacopœial use, since it would be constantly misunderstood to mean "grain," an amount representing less than one-fifteenth as much. The abbreviation "gm." is equally objectionable, because of its possible confusion with the abbreviation "grn." for "grain," so that the abbreviation "Gm." seems alone acceptable for medical and pharmaceutical use.

*Preparation of Manuscript.*—As the revision has progressed, a plan has developed which promises excellent results. When the sub-committee has completed its study of an article and submitted it through the General Chairman to the consideration of the Executive Committee and the new comments received have been given the necessary study, the text is then carefully edited. This new text, proposed as the form for the U. S. P. is then placed before the General Committee in duplicate, one set to be returned within two weeks. The members of the committee are requested to read this copy with the same degree of care heretofore given "galley proof," considering first the scientific facts presented, but also form, English construction, punctuation, typographical errors or any other feature presented. It is believed that this plan will eliminate most of the corrections when texts are placed before the committee in type and thus reduce the time and expense involved.

About fifty organic chemical texts have been placed before the committee in this form and fifty more are ready. The response has been most gratifying, about forty of the members having returned proofs, many offering valuable suggestions.

The next step will be a published abstract of the changes

proposed in text which have reached this stage of revision and only when texts have passed through this complete course can the final manuscript be made up.

*Date of appearance for the next U. S. P.*—For several decades there has been strong pressure brought upon the Chairman of the Committee of Revision to fix a definite date for the appearance of the new book. After the very successful conference of the committee in Philadelphia last July, one of the pharmaceutical journals predicted the appearance of the U. S. P. X. in late 1923.

Those who have had experience in Pharmacopœial revision know that the fixing of a definite date for its appearance is a mistake. First, because, if ample time is given after the book appears before the new standards are enforced, no interest suffers by withholding even a prediction of the time for its publication, and, secondly, because no one can forsee the complications and delays which may arise where so large a committee is working on a voluntary basis, and a failure to meet a promise would only bring criticism, embarrassment and disappointment to all.

The chairman and committee ask that those interested in the new revision accept the assurance that an earnest effort is being made to complete the new book as rapidly as is consistent with a thorough and creditable revision and that the proposed changes when published will of themselves be a fair indication of the progress of revision. Furthermore, it must be remembered that the printing of a book like the Pharmacopœia, with proof-reading by a large committee alone, requires at least a year for its completion.

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## SOIL-REACTION IN RELATION TO PLANT-GROWTH.*

At a meeting of the Philadelphia Botanical Club, held recently at the Academy of Natural Sciences, Dr. Edgar T. Wherry of the U. S. Bureau of Chemistry, gave an exposition of his researches on the relation of the soil-reaction to the growth of many of our com-

*Abstract of an address by Dr. Edgar T. Wherry at a meeting of the Philadelphia Botanical Club. Reported by Henry Leffmann, A. M., M. D., Lecturer on Research, Philadelphia College of Pharmacy and Science.

mon wild plants, comprising principally the herbaceous flowering forms. The subject is a comparatively new one in soil-chemistry, and suggests the possibility that the more extensive pursuit of it may consign to the scrap-heap a great deal of the data gathered during the last fifty years.

Soil-analysis has been pursued actively, and large amounts of money have been expended in its promotion in many nations. The U. S. Department of Agriculture has published many volumes of text and maps, giving results of such work in different parts of the country. Except, possibly, pastoral life, agriculture is the oldest systematic human employment, and for many centuries was conducted upon purely empirical methods, mixed with not a little superstition. Isolated and imperfect experiments were made from time to time in the centuries that immediately followed the revival of learning, but the practical ignorance of the composition of air, and the lack of correct methods of analysis of soil prevented any valid conclusions. Van Helmont weighed and planted a small tree in a tub after having weighed the earth therein, and watered the ground regularly. After the tree had grown considerably, he weighed it and the earth, and finding that the latter was about the same weight as at first, while the tree had gained a great deal, inferred that the water had been converted into plant tissue. He, of course, overlooked the carbon taken up from the carbon dioxide of the atmosphere.

A little before the middle of the last century, Justus Liebig presented, by request, to the British Association for the Advancement of Science an extensive report on organic chemistry in its relation to agriculture and physiology, which appeared somewhat later in English as "Agricultural Chemistry." In this he discussed the chemistry of the assimilation of the forms of plant food, and developed very extensvely the general principles upon which the study of plant nutrition has been pursued. He disapproved of the view that the emission of carbon dioxide by plants in darkness is a process of respiration, attended by a corresponding absorption of oxygen, and his attitude in this respect prevented the acceptance of such a view for many years.

For many years it was held that the fundamental condition for nutrition of plants is a supply of carbon, nitrogen, potassium and phosphorus in such combinations as can be easily absorbed and dif-

fused through the plant tissue. The carbon can be derived from the carbon dioxide of the air, the nitrogen can be obtained most satisfactorily from ammonium compounds and nitrates, the potassium and phosphorus from the natural salts of those elements. Continued experimenting, however, showed that many accessory conditions were influential, and the list of ingredients necessary to a fertile soil was being continually expanded. Bacteriology came into the question. The soil under all ordinary conditions is very rich in these organisms, and they play a much more important rôle than was at first supposed. They transform both organic and mineral matter into forms more assimilable by the plants.

Still more recently a new view of soil chemistry has come to the front, to the study of which several observers are giving much attention. This is based on the ionization of the soil solutes, that is, the substances dissolved in the water with which the soil is impregnated. It has been clearly established that the degree of acidity as determined by titration with alkali and an indicator, or a similar titration of an alkaline solution by an acid, gives but limited information as to the actual condition of the liquid, especially as to its reactions with living organisms. If we titrate equal volumes of two solutions, one containing acetic acid in the ratio of 60 parts by weight in a certain volume, and the other 63 parts of nitric acid in the same volume, the two liquids will require the same amount of alkali, but the actual conditions of activity of two acids is very different. In dilute solution, the whole of the nitric acid will be ionized, that is, all its hydrogen atoms will have assumed a positive charge, and all the $NO_3$ groups a negative charge, which will give them much higher activity. On the other hand, only a small proportion of the acetic acid has been so affected, and only a small number of its $C_2H_3O_2$ groups are in full activity. Alkali neutralizes the active groups, but as fast as such groups are removed, other acetic acid molecules ionize, and thus the supply is kept up until complete neutrality is affected. When acting against a living cell, however, no such neutralization takes place, so that the specific action is governed by the extent of ionization of the acid present, or if the reaction is alkaline by the degree of hydroxyl ionization.

The general subject of hydrogen-ion concentration has been extensively investigated of late years, and a system of symbols devised, which, after some irregularity, has been in large part, as far

as American writers are concerned, unified as pH. To this symbol an exponent is attached representing the degree of ionization in definite terms. Dr. Wherry has suggested special words for approximating different degrees, and among these is that the states of very small acidity and alkalinity shall be designated as "circumneutral."

The investigations have been carried on for some time, among a great number of plants and in very different regions. In his address, Dr. Wherry showed many illustrations of plants in place, and gave the facts in regard to the reaction of their soils. The determinations were made in the field. Small portions of the soil of the given plant close to the root were mixed with pure water and, after a short time had been allowed for the soil solution to mingle with the water, a clear portion of it was tested in depressions in a porcelain plate with the series of colors now available for the purpose. This is a special series of complex synthetic indicators, each of which has a distinct color-change for a given degree of ionization. This method is very convenient, and likely to be more accurate than the transportation of portions of soil to the laboratory.

The investigations so far made along this line by observers in different parts of the world show a fair degree of unanimity, indicating that each species of plant has its reaction preference, growing to best advantage under a certain condition of either acidity or alkalinity. Incidental points of much value in practical agriculture are foreshadowed by some of the data obtained. Thus, it has been found that the potato can flourish in a soil which has a reaction that is inimical to one of its parasites, so that by maintaining a proper condition the plant may be protected from disease. Some plants show, however, a degree of indifference to the soil reaction, growing about equally well in mild conditions of both alkalinity and acidity. Whether this difference is really due to a difference in specific form, not evident in the general appearance of the plant, is yet to be ascertained. In considering this subject, we must not overlook the fact that ordinary soil is not merely a store of inorganic food which the roots of the plant absorb, but a collection of organisms which are sensitive to the reactions of the soil-solution. Extended experience has shown that highly acid or alkaline soils or those heavily charged with neutral salts will interfere with many plants. The distinction between the marine and fresh-water flora emphasizes these facts

very strongly. Farmers have long known the injury that may be done by the too liberal use of acid phosphate as a fertilizer, producing a "sour" soil. In general, bacterial organisms thrive best in a medium alkaline to the common indicators, and most catalysts are also so affected. The general fertility of limestone soils has been known to agriculturists for many years.

The question may be asked as to origin of the acids of the soil. So far as unfertilized soils are concerned, the acidity in most cases is due to the decomposition of leaf structures. These fall on the ground dead, become the prey of many forms of simple organisms, and their complex proximate principles are converted into acids which are often collectively described as the humus acids. Carbonic acid is also a product of this action and is probably present in notable amount in all soils.

The subject is one of great complexity, the investigations of which are yet in their infancy. Many studies will have to be made over a great variety of plants and soils before positive conclusions can be drawn. Apart from the mere fact that a given plant is associated with a given soil-reaction, it may be found that by modifying such reaction within moderate limits, the character of the growth can be modified. It may be possible, therefore, to feed plants for certain products just as it is possible to feed animals for specific results. Those engaged in raising drug-yielding plants may discover soil conditions that will increase the production of the particular ingredient for which the plant is grown. The questions are purely practical in their present aspect, but the physiologist and chemist will have before long the duty of searching out the exact biologic reactions which determine the preferences in each case. Physical chemistry will be of direct importance; the earlier work of Graham, Dutrochet and Pfeffer will find wider and wider applications in both theoretical and practical agriculture, but it will probably be a long time before the questions as to whether the atom is a mere vortex of forces, and whether time is the fourth dimension, will need consideration by the bio-chemist.

# RADIUM: WHAT IS IT? WHAT DOES IT?*

By ARTHUR W. GOODSPEED,

*Professor of Physics, University of Pennsylvania.*

The duty has been imposed on me to state briefly, something of the physical properties of radium; what is it and what does it. It is the element which was discovered by Pierre and Mme. Curie more than twenty years ago. It occurs in all the ores which contain the well known element uranium. The subject is so broad and contains so much of well known and unknown science, that I will occupy a few moments in showing two or three demonstrations of radium and the material which comes from radium just as it itself comes from the parent substance which produces it. Radium seems to be the key to inorganic evolution. Just as everything organic changes with comparative rapidity, so it has been shown by a study of radium and some other inorganic substances that they too are constantly undergoing a change and that the radium which we have all read about and which we are always learning more about, was originally a part of the inorganic element uranium. In the changes of uranium down through various substances we have three or four steps before arriving at radium. Uranium is the most massive of any element we have and perhaps for this reason it is more likely to change spontaneously. Radium is known to disintegrate into a definite number of substances and this is accompanied by the ejection of several kinds of so-called rays, known as alpha, beta and gamma rays. The alpha rays are material particles atomic in size carrying a positive electric charge. After losing this charge these particles are helium atoms. The beta rays are particles subatomic in size and are atoms of negative electricity, *i. e.*, electrons. The gamma rays are like light rays of exceedingly short wave length. They are similar to very short X-rays. The radioactive process is an atomic explosion, the particles being emitted with great speed from $\frac{1}{10}$ to $\frac{9}{10}$ that of light. This implies a vast store-house of intra-atomic energy. A gamma ray starts as an ether pulse at the instant an electron is emitted, just as an X-ray starts when an electron is sud-

*An abstract of a Foyer Lecture delivered at the Academy of Music, Philadelphia, December 13, 1921.

denly stopped. Starting and stopping is just the same kind of an act, one being the negative of the other.

I have here a small piece of uranium ore known as carnotite which is the chief source of radium in this country. As it contains, however, only about 2 per cent. of uranium the radium content is only about five milligrams per ton of the ore. It is readily seen why radium is so expensive to obtain; there is very little of it and the labor necessary to get it is very great. The material that Mme. Curie worked with in her early experiments in 1898 was the residue of some of the Austrian uranium mines after the uranium had been extracted from the ore. Becquerel had discovered in 1896 the remarkable property of uranium known as radioactivity and this suggested to the Curies the probable existence of other substances in uranium ore. Thus Mme. Curie with her husband came to find radium a far more active substance than uranium. At once other chemists in Europe separated small quantities of radium and I have the privilege of showing you the first samples of radium to be seen in this country. This was in 1899. My predecessor at the University, Professor G. F. Barker, was in Europe at the time and secured these from the de Haën Laboratory in Hanover. The percentage of radium content in these samples is obviously very small but note that the material cost but $2 per gram while the single gram recently acquired by Mme. Curie cost our ladies of America about $100.000. Please notice the blue color of the bottles which has been produced by the rays. Also a very faint luminosity can be detected in the dark. This is interesting as many substances acquire this property while radium rays impinge upon them. One of my associates at the University, Dr. Kabakjian, after at least two years of effort has worked out a very efficient method for extracting radium from low grade carnotite and his process is being used at the Radium Chemical Works at Lansdowne near this city and I am indebted to Mr. W. L. Cummings, the proprietor of that plant, for the loan of several thousand dollars worth of radium for experiment here. This morning Dr. Kabakjian very kindly prepared for me this cylindrical glass tube thinly coated within with zinc sulphide.

The first disintegration product from radium is a gas which is itself many fold more active than radium. An atom of this gas is formed by the expulsion of an alpha particle from an atom of radium and the gas is called radium emanation or niton. It is thought

that these atomic reductions go on till finally a lead atom results. If there is further change it is so slow as to escape detection.

Within the tube referred to and which I hold in my hand a very minute quantity of the gas niton has been placed. Within the Dewar flask there is liquefied air which is exceedingly cold having a temperature of 190° C. If I dip the tube part way in the liquid air the niton within will be precipitated as a solid upon the zinc sulphide because of the cold and the salt will at once become quite luminous over the surface immersed due to the impacts of the ejected alpha and beta particles and the gamma rays. This process will quickly proceed till most of the niton is condensed and the lower part of the tube is very bright. These particles are emitted with the tremendous speed of 20,000 miles per second and more. We may thus picture to ourselves a possible mechanism through which radium produces a therapeutic effect either for good or ill. These particles are very, very fast moving bullets which may destroy organisms when they hit.

But I must hasten to another experiment which Dr. Kabakjian has prepared for us, and which illustrates a result from his own researches in radioactivity. He has named the phenomenon thermo-radio-luminescence. Here is a tube which contains 25 millgrams of radium bromide of rather high grade. It was heated some hours ago and under the bombardment of its own rays it is perhaps the brightest specimen of radium any of you have ever seen. The energy transformations in this experiment seem to be in a reverse order from those in the well known phenomenon of thermo-luminescence in which the specimen is first subjected to the action of rays and then heated.

Since radioactive substances are constantly ejecting particles and radiation, the inference is that the energy used is within the atom and thus we have discovered a vast store-house of intra-atomic energy which in the case of each atom can be calculated though it cannot now be controlled. For example if it were possible to extract and use at will the total intra-atomic energy of the gram of radium Mme. Curie has recently received it would be sufficient to transport her with her two daughters in an automobile from here to her birthplace in Warsaw if we only had a good bridge over the Atlantic.

# ABSTRACTED AND REPRINTED ARTICLES

## THE LEECH AS A REMEDIAL AGENT.

### Usefulness of These Little Fresh Water Annelids Still Persists Despite Advances in Therapeutic Science Since the Ancients First Described and Made Use of Them.

(Reprinted from *The Pharmaceutical Era.*)

Although the leech is not given a place in the United States Pharmacopœia, it is nevertheless an important remedial agent. Indeed, it is doubtful if any agent or drug of animal origin has ever been more prominently brought under notice than the leech, both on account of its use in medicine from a very early period, and on account of its fitness for anatomical and other investigations relating to the study of the animal organism. The leech has formed the subject of treatises, inaugural, historical and structural, the number devoted to it being very considerable.

#### KNOWN TO ANCIENTS.

From the historical side the ancients seem to have been well acquainted with leeches, but it is doubtful if they knew much about their use as a remedial agent. In Greek medicine, apparently, leeches were not known until a comparatively late date, the first mention of them being ascribed by some writers to Themison of Laodicea, who is said to have practiced in Rome about 50 B. C. Besides being the first known physician to make use of leeches for remedial purposes, Themison is also credited by Wootton ("Chronicles of Pharmacy") with being the first to use the famous Pulvis Aloe at Canellæ or Hiera Picra, "a remedy which can be bought in any drug store in Europe or America today, just as it could in Damascus, a thousand, or in Rome and Alexandria, two thousand years ago."

During the middle ages practically all of the Latin and Arabian medical writers described the uses of leeches, as well as the methods of keeping and applying them, and, furthermore, of meeting casualties which might occur from their employment. In early Roman literature Horace seems to have been well acquainted with the tenacity or

"sticking propensity" of the leech, for he manifestly makes use of this proclivity as an example of perseverance. Thus, in his observation, *"non missura cutem nisi plena cruoris hirudo,"* which literally translated means that "a leech does not quit the skin until it is full of blood."

While the zoologist is able to enumerate many species of leeches, only two varieties are usually employed for remedial purposes. These are officially described in the British Pharmacopœia as fresh water annelids, the varieties being the speckled leech (*Sanguisuga medicinalis*) and the green leech (*Sanguisuga officinalis*), the term "sanguisuga" meaning "bloodsucker." They have a soft, smooth body, about 5 centimeters in length, tapering to the extremities, both of which are provided with disc-like suckers. The anterior sucker is the smaller and surrounds the tri-radiate jaws, by which the leech effects an incision in the skin. The body is marked with from ninety to one hundred annulations, the dorsal surface being olive-green, with six rusty-red longitudinal lines. The ventral surface of the speckled leech is greenish-yellow, with black spots, while the ventral surface of the green leech is olive-green, with a black line.

### THEY VARY IN SIZE.

This official description fits most of the leeches imported into this country. As described by one importer, the leeches are usually olive-green to brown, with darker patches and spots scattered over a paler ground, a full gray-brown to dark-green or black being the predominating colors. They also vary much in size, some being less than half an inch in length, while others measure from three to five inches. There are leeches belonging to the same family which are said to measure fully two and a half feet in length, but these are rarely used, as they would extract too much blood. Most of the leeches imported here come from France, Italy, Russia and Germany. Before the beginning of the World War, Hamburg was one of the principal exporting centers for leeches from Poland and the Ukraine. Exports of leeches from Turkey, Wallachia, Egypt and Algeria, are also occasionally noted, while Bordeaux is an important center for supplies reaching practitioners in the French Republic.

Many travellers have written interesting descriptions of the methods employed by the natives of different countries in gathering leeches. In some places ponds are maintained for the propagation of

leeches, and they say it is not an uncommon practice in some sections for the dealers to drive horses and cows into the ponds in the belief that the leeches by sucking the blood of the animals will fatten and propagate more abundantly. Not infrequently children are employed to catch the leeches by hand, while grown persons wade into the shallow waters in the spring of the year and catch the leeches which adhere to their naked legs. In summer when the leeches have retired to deeper water, a sort of raft is constructed of twigs and rushes by which a few are entangled. Baits of liver are also employed to gather the leeches, these attaching themselves to the bait being then removed by hand. By some writers this method of capture is said to make the leeches sickly.

### A HARDY ANIMAL.

Menniere, writing nearly fifty years ago, interestingly described the leeches common to the marshes of Anjou. Practically all species were represented as well as numerous varieties. In certain varieties a considerable difference was found to exist, depending upon the character of the marsh where the leeches were reared. These differences, he reported, were easily distinguishable by the experienced fisher, who was able to tell the official leech, which had lived in the marsh in the midst of vegetation from one which had been taken in waters free from vegetable growth. In fact, the same varieties of leeches which had been taken from different sources no longer presented identical characteristics. Menniere attributes only secondary importance to the expressed belief of some persons that the color of the water influences the color of the leech, but he does contend that the chemical nature of the water has an important bearing upon the abundance or scarcity of the leeches which are to be found in a given region or district.

Usually leeches are quite hardy, although they are sometimes subject to great mortality. The Edinburgh Dispensatory, published early in the nineteenth century, more than a hundred years ago, records an epidemic that destroyed very generally the supplies of leeches of many druggists in the United Kingdom during the years 1798 and 1799. The cause of this epidemic seems not to have been known. Probably one of the causes of greatest mortality among leeches is due to the manner in which they are stored or kept. Some dealers state that it is necessary to keep aquatic plants in the vessels

or jars in which the leeches are stored, the presence of such vegetation, it is claimed, providing a structure against which the leeches may rub to rid themselves of the slime which their skin exudes.

### HAVE BAROMETRIC QUALITIES.

Leeches change their skin frequently, and at such periods they are subject to indisposition and show no eagerness to bite. It is claimed by some writers that leeches are most averse to biting in cloudy or rainy weather, or in the evening. One French observer some years ago reported the effect of the weather on leeches by saying that the leech is an excellent barometer. If the leech remained curled up at the bottom of the container or aquarium, the action indicated fine weather. When it rises to the surface, unsettled or rainy weather should be expected. If it moved about rapidly, a windy spell was imminent, while if the leech indulged in convulsive somersaults, thunder was at hand.

In practical medicine, leeches are used to reduce congestion and inflammation in such conditions as pleurisy, pneumonia, ophthalmia, pericarditis, inflammation of the ear and kindred affections. Each leech is said to draw on an average about ninety minims of blood, which when so withdrawn, loses its property of coagulating. This loss of coagubility is due to the admixture of the blood with the pharyngeal or buccal secretion of the leech which contains the active substance known as "hirudin." In the act of sucking, this secretion is also injected into the place bitten, and is in some degree the cause of the persistent hemorrhage that sometimes follows the removal of the leech.

Leeches should not be applied directly over the inflamed tissue, but to the surrounding area. Neither should they be allowed to take hold directly over a superficial artery, vein or nerve, or be applied to a part where the skin is delicate or where there is a large amount of loose cellular tissue, as the eyelids, since extensive discoloration may result from the super-induced hemorrhage.

Leeches are usually applied to the part affected by means of a leech glass; or a hole may be cut in a piece of blotting paper, and the leech confined to its position by a pill box or tumbler. It can also be easily applied by inserting it tail first in a small, narrow bottle, and then inverting the bottle and holding it against the skin at the

point desired. If the leech refuses to bite, the skin, after thoroughly cleansing, should be moistened with a few drops of sweetened milk or a little blood drawn from some other part of the body.

### HOW TO STORE THEM.

While a single leech will draw from one to two teaspoonfuls of blood, after-bleeding may greatly increase this amount. If the leech does not fall off when desired, a little salt sprinkled over it will cause it to loosen its hold. A leech should never be used twice, neither should it be pulled off with the fingers. When it is removed after having abstracted sufficient blood, it should be thrown into the fire and burned. Never throw it into the toilet bowl. The practice of using over again leeches which have been made to disgorge the blood they have sucked, is to be condemned, as there is danger of carrying infection from one patient to another. Excessive bleeding from leech-bites after removal of the leech may be stopped by continued pressure with the application of lint, by the use of collodion, or by touching the wound with lunar caustic. The dusting on of a little powdered alum has also been recommended.

Various methods and containers have been suggested for storing leeches and keeping them alive. J. A. Firestone & Brother, of Scranton, Pa., one of the largest receivers of imported leeches in the United States, and to whom we are indebted for some of the facts herein set forth, say that leeches are best kept in a jar of water covered with a perforated top and having a little mud in the bottom. It is not necessary to change the water daily. Some druggists find it advantageous to place moss or aquatic plants at the bottom of the container, contact with these growths enabling the leeches to free themselves from slime. Other dealers keep as many as 50,000 in a large tank of water, the tank being floored with soft clay and pebbles.

For the local abstraction of blood, leeches are to be preferred to cupping glasses, especially where the parts are very sensitive. Of course, where the parts are irregular, only leeches can be used. Unquestionably leeches "constitute an important therapeutic agent and in many instances give to the physician a control over disease which he could obtain in no other way." The most common objection one hears to the use of leeches is that it is often almost impossible to get them when they are most needed.

# THE RELATION OF PHARMACOLOGY TO LEGAL MEDICINE.*

By ROBERT A. HATCHER,

*Professor of Pharmacology, Cornell University Medical College, New York City.*

PHARMACOLOGY, in the broadest meaning of the word, is synonymous with medicine; in the narrower sense in which it is commonly used it means the science that deals with the actions of drugs on animal tissues, including those of man. The therapeutic use of drugs is based on a knowledge of their pharmacologic actions. Thus, pharmacology teaches that morphine and codeine both relieve cough, but morphine has many other actions, and the therapeutist must decide in any given case whether it is better to use morphine or codeine.

Chemistry and therapeutics have so long held the ascendency in legal medicine that the rapid development of modern pharmacology has not received much consideration from members of the bar. It is not the purpose of this article to convey the impression that chemistry and therapeutics have become less important in legal medicine. On the contrary, their importance has increased with advances in our knowledge of those sciences, but it is necessary to direct attention to ways in which pharmacology is capable of serving the ends of justice. This may be presented best, perhaps, by means of a few examples taken from experience. Full details cannot be given without betraying confidence, but such details are not necessary in a paper which is intended to be suggestive only.

The writer does not vouch for the accuracy of every statement that was made to him in presenting the cases, but the arguments are based on the assumption that such statements were correct.

An adult was drowned; a chemist isolated more than a grain of morphine from the liver, bile and intestine, but he could not say how much of the morphine was found in each of these. The testimony showed that the poison had been swallowed some hours before death. The writer was asked whether in his opinion the deceased would take morphine for the purpose of rendering suicide by drowning painless.

*Reprinted from *Law Notes*, November, 1921.

He could form no expert opinion on that subject. He could testify that in his opinion the deceased would not be in a condition to carry out the several steps that were necessary to commit suicide in the manner indicated, because enough of the morphine had been absorbed to induce narcosis. He could also testify that narcosis would greatly facilitate the murder of the deceased by drowning in the manner described. It may be added that much valuable information could have been gained had the writer consulted with the chemist before the examination for morphine was made.

The accused became convinced of the weakness of their defence—that the deceased had taken morphine to render suicide by drowning painless—and confessed to the murder.

A woman drank a glass of a beverage, her husband tasted the beverage, the remainder of the contents of a bottle of which he had poured into a glass; he complained that it was too bitter and threw it out. Both had convulsions; the woman died. The beverage had been purchased by the case, which was kept in the cellar, and the bottle had been opened immediately before the incidents described. The nature of the convulsions suggested poisoning by strychnine, and a few drops of the beverage, obtained by draining the glasses and the bottle, were sent to the writer for examination. He was able by means of experiments on frogs to estimate that the bottle contained about four grains of strychnine; the amount present in the specimen submitted was far too small to be isolated in pure form and weighed, hence a chemist could not have determined the amount present by chemical means.

A pharmacologist would deduce from the foregoing facts some valuable evidence. It suggests that the deceased died as a result of murder or suicide; that the one who placed the strychnine in the bottle knew about how much would be necessary, because much less would not have proved fatal when a glass of it was taken, much more would have rendered the beverage intensely bitter and unfit to drink. Since most members of the laity have only the vaguest ideas of the actual amounts of various poisons required to cause death, the fairly accurate adjustment of the dosage in this case points strongly to the fact that the guilty person was a nurse, chemist, or physician, or had made careful inquiry of one so informed. Few persons previously possessing such knowledge would in the natural course of events,

have both the motive and the opportunity to add poison to the beverage kept in the cellar of the deceased.

If the husband merely "tasted" the beverage, he did not take enough strychnine to cause convulsions. Were they feigned? Careful investigation could easily have shown the facts in the case. More of the circumstantial evidence in this case might be added, but the writer was given to understand that his duties in the matter ended when he reported the approximate amount of strychnine present in the beverage. Enough has been said, however, to show that the active co-operation of a pharmacologist would be valuable to a prosecuting officer in such a case.

A man took one of ten powders that had been prescribed for him and vomited every day for many weeks thereafter. It was charged that the pharmacist who compounded the prescription made a mistake resulting in this illness. The writer was asked to examine one of the powders in order to determine whether a mistake had been made; a copy of the original prescription was sent with the powder. The examination showed that the pharmacist had indeed made a mistake, but it was of such a character that no possible harm could result from it, as the substance substituted was practically identical with that prescribed, and furthermore, the powders dispensed could by no possibility induce vomiting of the character described.

It may be stated in passing that many people look upon any mistake made in compounding a prescription as certain to cause injury, and there is a widespread disposition to claim damages when there is evidence of a mistake of this character, but in truth the precautions commonly observed in reputable pharmacies render serious mistakes rare, though minor mistakes are not very uncommon.

A man drank part of the contents of a bottle, was taken seriously ill shortly thereafter and was treated by a physician employed by the establishment that furnished the liquid by mistake for another substance. Contrary to the advice of the physician the man left the establishment within a few hours, but was taken ill and was removed to a hospital where he remained a few days. After recovering, apparently, he went to his home and died about three weeks after drinking the fluid mentioned.

The writer was asked at ten o'clock A. M. whether he could testify in court at two o'clock P. M. that the liquid in question was not a poison. He replied that he could not, because it is a poison.

He stated that he could testify that the liquid was not the cause of death. He suggested that a postponement be obtained, that a transcript of the records of treatment and of the symptoms exhibited by the deceased be obtained, in order that these symptoms might be compared with those induced by poisoning by the liquid in question. As far as the writer was able to learn the suit that had been instituted for damages was dropped. It was very easy to show that the liquid did not cause death in this case.

The laity and many members of the legal profession have only vague ideas regarding poisons, the word having a sinister meaning to the average mind, so that it is often difficult to convince one when the has suffered serious injury following the taking of a poison through mistake, that the poison is not necessarily responsible for his injuries. It must be remembered that poisons are frequently taken by mistake by those who are ill and who would not otherwise have occasion to take any drug. Under such circumstances the poison may induce violent symptoms after which the effects may pass away completely, but that does not mean that the disease from which the patient suffers may not continue to grow worse exactly as it would had the poison not been taken. When a patient dies under such circumstances it is easy to attribute his death to the poison taken through error.

While a patient might be entitled to damages for the pain and discomfort induced by the poison in such a case, this is wholly apart from the far more serious question of whether death is the result of the mistake that resulted in his taking the poison. A somewhat analogous condition was presented to the writer after a physician had stated that a mistake of this character had caused injury. Death did not result in this case. The writer declined to testify, as he was convinced that the relatively slight mistake was not responsible for the symptoms attributed to the poison. Such cases demand the close co-operation of the physician and the pharmacologist.

Experiences such as these just detailed might be multiplied indefinitely if one were treating of the subject exhaustively, but it is believed that the cases cited suffice to show that the pharmacologist may often give valuable aid in the solution of medico-legal problems.

# NOTE ON PHARMACEUTICAL NOMENCLATURE: NUCLEIN OR NUCLEIC ACID, SCOPOLAMINE OR HYOSCINE. *

By Joseph John Blackie, Ph. C.

## NUCLEIN OR NUCLEIC ACID.

There seems to be some doubt and misconception as to the meaning of the two terms "nuclein" and "nucleinic" or "nucleic acid," and perhaps before going any further a short note on the chemistry and preparation of the two substances will help to enlighten matters and show that they are quite distinct articles of pharmacy.

The nucleoproteins are complex compounds which are made up of varying amounts of protein and nucleic acid. Nuclein is the product obtained when a nucleoprotein is hydrolysed. The nucleoprotein on digestion with hydrochloric acid and pepsin is not completely hydrolysed—that is, it is not completely separated. A residue remains which is insoluble in the pepsin solution and consists of protein combined with nucleic acid. This residue is called nuclein. Nucleins are therefore the insoluble residues which remain after the tissue has been digested with pepsin, and it will be seen later that nucleic acid can be separated from the nuclein. The chemical constitution of nucleic acid has not yet been definitely ascertained, but it is said to consist of a carbohydrate, phosphoric acid, purine and pyrimidine bases. Plant nucleic acid differs from animal nucleic acid in the carbohydrate constituent, and also in one of the pyrimidine bases.

The nucleoproteins are present in the pancreas, thymus, etc., but the product met with in pharmacy is usually prepared from the nucleoprotein of yeast. The yeast is extracted several times with dilute solution of ammonia. The mixed extracts are acidified wth dilute hydrochloric acid until faintly acid. The brown or dirty white precipitate obtained is nucleoprotein. From this nucleoprotein, nuclein is obtained by adding dilute solution of hydrochloric acid and a solution of pepsin, and digestion is carried out by incubation for forty-eight hours. The albumin is split off as peptone and the nuclein is precipitated as a brown sediment. It may be purified by dissolving in ammonia and precipitating by the addition of dilute solution of acetic acid.

*Reprinted from the *Pharm. Journ. and Pharmacist*, Dec., 1921.

Nucleic acid is prepared directly from yeast, but may be obtained from nuclein, and so to emphasize the difference between the two compounds a short note on the preparation from nuclein is given. The nuclein is decomposed by adding solution of caustic soda, and the alkali is neutralized by the addition of dilute hydrochloric acid. Acetic acid is then added to precipitate the protein. The solution is filtered, and to the filtrate is added solution of hydrochloric acid in alcohol. The precipitated nucleic acid is collected upon a hardened filter paper, and may be purified by dissolving in ammonia and precipitating with acid alcohol. It is then dried over sulphuric acid. It is a white amorphous powder, slightly soluble in water, insoluble in alcohol and ether, but readily soluble in dilute solutions of potassium or sodium hydroxide. Thus in the chemical constitution and preparation it is seen that the two substances are quite distinct.

The confusion between the two compounds has probably arisen from the description given in the British Pharmaceutical Codex, where the nomenclature is misleading. This book, under Acid Nucleinic, gives the synonyms Acid Nucleic and Nuclein, and the description in the text does not agree with the synonymous terms stated. It states that "if yeast, spermatozoa, or pus cells be extracted with acids a residue is obtained which has been termed nuclein. This residue is acid and contains a considerable amount of phosphorus. If it be further treated with alkalies, or is subjected to tryptic digestion, the protein is split off, the nucleic acid which remains containing all the phosphorus." This description does not justify giving nuclein as a synonym of nucleic acid because it shows that the latter substance is a decomposition product of the former one, therefore quite a separate compound. It goes on to state that "the term nuclein is commonly used as a synonym of nucleic acid, but that it is more correctly applied to the nucleinates intermediate between nucleic acid and nucleo-protein."

The fact remains that by giving nuclein as a synonym of nucleic acid much confusion is caused, because pharmacists when dispensing have not always time to go into details when a prescription is urgently wanted, and by consulting the B. P. C. and noting that the terms are synonymous they take if for granted that that authorty is correct. Nucleic acid is usually prescribed as it is soluble in solutions of weak alkalis with the formation of the corresponding nucleinates, and it is in the form of a five per cent. aqueous solution that it is chiefly

used in medicine. Pure nuclein is not often met with in pharmacy, but the nucleoprotein of yeast is occasionally dispensed under the name of nuclein. This compound, which is the product obtained in the preliminary preparation of nuclein, is insoluble in water and alkalis, and is usually prescribed in tablet form.

In "Squire's Companion to the Pharmacopœia" and Martindale's "Extra Pharmacopœia" the two compounds are clearly and separately described. In the latter book the term nucleol is given as a synonym of nuclein. This is stated in the U. S. "Dispensatory" to be a free form of nuclein.

### SCOPOLAMINE OR HYOSCINE.

The terms "scopolamine" and "hyoscine" are synonymous but the former seems to be coming into use by certain sections. There is no reason for this change, as the alkaloid is official in the B. P. as hyoscine hydrobromide, while scopolamine is given as a secondary term. This alteration in nomenclature is probably due to continental influence, scopolamine being in some Pharmacopœias the official name of the drug. Hyoscine, as will be seen later, is the older name of the alkaloid, and being so should be given the preference. Pharmacists and medical men should not drift away from the official to synonymous in their nomenclature.

No pharmacist or medical practitioner would ever think of using the term theine for caffeine or di-sodium hydrogen phosphate for sodium phosphate. These terms, like scopolamine, are considered either as indicating the source of the drug or merely as technical nomenclature, and are given in the B. P. as being of minor importance to the pharmacist. There is no reason, therefore, why scopolamine should be used in place of hyoscine, which was the name first applied to the alkaloid. Hyoscine was the name originally applied by Höhn and Reichard in 1871 (*Annalen*, 1871, 157, 98) to a basic product of the hydrolysis of hyoscyamine, now universally called tropine, and having the formula $C_8H_{15}ON$. Later in 1880, Ladenburg (*Annalen*, 1880, 206, 299) gave the name hyoscine to a new amorphous alkaloid obtained from the mother liquids of hyoscyamine. This he erroneously took to be an insomeride of atropine with the formula $C_{17}H_{23}O_3N$. Schmidt, in 1892 (*Arch. Pharm.*, 1892, 230, 207; 1894, 232, 409), found Ladenburg's new alkaloid had the formula $C_{17}H_{21}O_4N$, and was identical with an alkaloid Schmidt found in the rhizomes of *Scopolo japonica*, and to which he gave the name scopolamine. This

identity of hyoscine and scopolamine was confirmed by Hesse in 1892 (*Annalen*, 1892, 271 120; 1893, 276, 84). Thus, though Ladenburg was not quite correct in his chemical formula, he undoubtedly was the first to give a name to the alkaloid now called both hyoscine and scopolamine. Historically, therefore, hyoscine has the priority. The term hyoscine was accordingly adopted in British pharmacy, and there may be a danger of its falling out of use on account of the introduction of scopolamine.

Scopolamine, as shown above was the name provisionally applied to a crystalline alkaloid isolated by Schmidt from a species of *Scopola*, but when this alkaloid was found to be chemically identical with hyoscine the term scopolamine was probably intended to be dropped. It is, however, given in our books of reference as the synonym of hyoscine, and, in fact, introduced into some Pharmacopœias, where it is fully described, and where hyoscine is given the minor place as a synonym of the drug.

It might be argued that scopolamine describes the alkaloid equally well, because certain species of Scopola give a good yield of the substance, and that the name indicates the source of the drug. Certain species of *Datura*, however, contain hyoscine, and are the commercial sources of the alkaloid; so on the same argument, a name suggesting *Datura* as the source of the drug might be used. This would complicate matters very much and so, to simplify nomenclature, the term scopolamine should be discarded, and the official and old-established name of hyoscine should be the one and only term used.

The retention of the old name of hyoscine was advocated in an article by Hesse, which appeared in *The Pharmaceutical Journal* in September, 1892, where he states "that it would be inappropriate to alter the name of the substance, more especially since the name hyoscine has been long established in medicine and pharmacy as well as in the trade, while, on the other hand, scopolamine, which is scarcely known, would first have to become familiar." He goes on to state "that he would urge chemists to adhere to the use of the name of hyoscine, which was selected by Ladenburg for the base in question, and has been in general use up to the present time." From other remarks of Hesse it would appear that the term scopolamine was not intended to be used, as the name was given only as a temporary measure, there being at the time some doubt amongst chemists whether the two substances were identical or not.

# LAC CULTIVATION.

By S. MAHDI HASSEN, BANGALORE.

Lac is defined as a crude expression for all of the products of an insect called *Tachardia lacca*. Lac upon removal from the tree is called "stick lac." It contains among other things resin, wax and dye. Only the resin usually enters the market either as flat cakes (button lac) or in the form of orange colored sheets (shellac). Stick lac differs in its constituents according to the tree from which it is derived. Koosam lac produced by propagating the insects on *Schleichera trijuga* is claimed to be the richest source of shellac, containing 70 to 80 per cent. of resin, the shellac produced being elastic and of a golden orange color. The central provinces of Western Bengal produce most of the koosam lac.

*Pitholobium Saman* is the chief host plant of lac in Burma. This lac contains 12 per cent. of dye and gives the shellac obtained therefrom a reddish tinge. Peepal or *Ficus Bengalensis* yields a very pale colored stick lac but its resin is of poor quality. The shellac obtained therefrom is brittle. The greatest amount of lac is derived from Palas or *Butea frondosa*. It contains 60 to 65 per cent. of resin. Barie or *Zizyphus jujuba* yields lac a little superior to Palas, containing about 5 per cent. more or resin. Trees producing lac not inferior to Palas are *Pterocarpus Marsupium, Shorea robusta, Acacia arabica* and *Terminalia tomentosa*. Most host plants of lac belong to the *Leguminosæ*. All of the host plants of lac contain substances like hydroxy acids, tannins and gums. A tree containing tannins and water soluble gums is likely to produce lac.

The lac parasite lives upon the disease of the tree, upon the vigor of the tissue destroying gum bacilli. The lac insect lives upon sweet bacterial gums produced by tissue destruction.

The reason it is not thought that the insect feeds on tissue building sugars is that during the summer, when carbon assimilation is at its best, the crop of lac is very poor.

Tannin is regarded as essential for the production of slime, abundance of gums and so of lac. Among the predisposing agencies in tannin formation are mentioned salts of soda and potash, dry piercing winds and low ground fires.

The enemies of the lac insect include the larvæ of some moths and chalcid flies. To destroy these a wholesale ground fire is recommended.

Since the host plants of lac are leguminous, the nitrogen fixing bacteria which help these trees are constantly in need of fresh air. During summer when these bacteria are very active the hard surface soil should be broken. Grazing animals, termites and ants are valuable agencies in loosening the soil and letting in air. Ants in return for their food protect the lac insect from its enemies and so are helpful to both host and parasite.

Grazing, while useful during the hot season, is injurious during the rains on account of pressing the surface soil.

A soil bad for the forester and worse for the farmer, where more weeds are found than crops and whereon fire annually annoys the forester, is ideal for lac production.

Early crowding and deferred severe thinning is the best treatment for the host plants of lac.

Iron in the soil predisposes the tree to the attack of the lac insect, In conclusion the author appeals for a system of intense cultivation, making the most of the worst possible soils and climatic conditions and viewing lac as a major forest product.

H. W. Y.

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## RECENT ADVANCES IN FOOD AND DRUG CHEMISTRY.

ABSTRACTS PREPARED BY DR. HENRY LEFFMANN.

The latest report of the United States Bureau of Chemistry, just released for publication, contains many interesting and important notes, from which a few directly concerning pharmacy are herewith abstracted.

### NATIVE SOURCES OF CAFFEINE.

The scarcity of Caffeine during the war led to a search by a department of the bureau for possible native sources. The leaves of the *Ilex vomitoria,* which is found along the coast from Virginia to Texas. contain an appreciable amount of the alkaloid, as does also the pulp of the coffee berry, millions of pounds of which become available every year in Porto Rico.

GENUINE SYNTHETIC APPLE OIL.

Studies in the phytochemical laboratory of the bureau have resulted in the discovery of the ingredients of the mixture which gives the characteristic flavor to apples. On the basis of the results obtained, a synthetic oil, identical in composition and properties with that found in apples has been produced and a "public service patent" has been granted for the procedure. This is an important step in the detection of food adulteration, for unless the composition of the flavoring material of given fruit is fairly accurately known, the distinction between the true flavor and substitutes is not definitely ascertainable. Work is being done along this line with peaches, and also to determine if methyl anthranilate is a natural constituent of any varieties of grape and for developing a trustworthy test for this ester.

NEW SUGARS.

The Carbohydrate Laboratory has isolated two sugars with seven carbon atoms, the first of the type so far detected in natural products.

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## TOXICOLOGY IN THE ANTIPODES.

ABSTRACTS PREPARED BY DR. HENRY LEFFMANN.

In the proceedings of South African Chemical Institute for September last, several accounts of poisonous plants are given. The region is somewhat interesting as being the other U. S. A. Union of South Africa. The data are given by Joseph Lewis, A. M., D. Sc.

ARROW POISON.

Acocantherine is a constituent of Bushman arrow-poison; other ingredients are: snake venom, euphorbia latex and a fluid from the larva of a beetle. Acocanthera is used as an antidote to snake poisoning, but its powerful stimulant action on the heart is such that it is not impossible, Dr. Lewis thinks, that the two poisons may be used together. Euphorbia latex is probably used as a cement. Only two specimens of the poisonous larva were obtained. The poisonous ingredient is probably a toxalbumin. It acts directly on the blood, killing the leucocytes and dissolving the red corpuscles. Direct injection into the blood is far more rapid in action than subcutaneous injection.

Twelve milligrams killed a rabbit in a few minutes by intravenous injection, while several days was required after subcutaneous use. Birds are much more resistant than mammals. Post mortems invariably show in mammals inflammation of the kidneys and intestines, but not of the stomach. Animals can be rendered immune by repeated small doses of the material.

### POISONOUS SENSITIVE PLANT.

Under the common name of "Kruidje roer my niet" (Dutch, for "Touch me not plantlet,") several species of *Melianthus* have attracted attention on account of poisoning. *Melianthus comosus* was the cause of the death of a sickly native who was attended by a native doctor. The alcoholic extract of the bark yielded on evaporation a mixture of water-soluble (toxic) material and a resinous substance. The toxic principle is also soluble in ether and chloroform. The only color reaction obtained the material after purification was a momentary salmon pink, changing to brown, with sulphuric acid.

### LOVE PHILTRES.

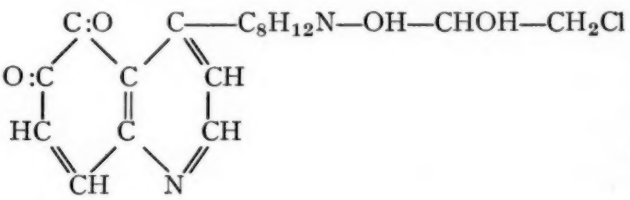
As might be expected, these are much in use among the natives. The misletoe is credited with such powers in South Africa as well as in Europe, but in the latter, the plant is regarded as active when growing on the oak, and in Africa when it grows on the mimosa. Dr. Lewis, however, has not met with any cases of the use of the mistletoe, but noted several instances of the use of cantharides. The beetle lives on several species of *Mylabris*. One instance is reported of the use of a tabloid of blasting gelatine, given to a girl for aphrodisiac effects. The result is not stated.

# SCIENTIFIC AND TECHNICAL ABSTRACTS

OLEANDER.—The amount of digitalis-like active substance in the leaves of Nerium Oleander has been investigated by Walther Straub. He finds the oleander leaves to be 2.5 times as active as digitalis leaves and the aqueous and alcoholic extracts to be very stable. *Archiv für Exp. Path. u. Pharm.* 82, pp.327-43 (1921).

J. F. C.

THALLEIOQUIN.—After an extensive investigation of the subject Christensen has reached the conclusion that thalleioquin is the ammonium compound of 5-6, diketochinchonineoxychloride:




*(Ber. d. d. pharm. Ges.* 26, 2249 [1916].)

J. F. C.

IDENTIFICATION OF ACETALDEHYDE AND FORMALDEHYDE.—An intense crimson color is developed by mixing in the cold and in the following order acetaldehyde, phenylhydrazine, diazobenzene (obtained by the action of sodium nitrite and hydrochloric acid on sulphanilic acid), and sodium hydroxide solution. This reaction is stated to be capable of detecting acetaldehyde in dilutions of 1—350,000. Formaldehyde gives an intense blood-red color on mixing cold with phenylhydrazine, metol, and sodium hydroxide. This reaction mixture gives a blue lake with magnesia. It may detect one millionth part of formaldehyde and, used as a test for phenylhydrazine, will detect it in dilutions of 1—250,000; or will detect metol in dilutions of 1—300,000. The test may be directly applied to organic liquids

such as milk, urine, food products, etc. It is prevented by the presence of ammoniacal salts or of any substance able to neutralize the added alkali. J. F. C.

E. Pittarelli, *Arch. di farm. sper.* 30, p. 148 (1921).

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DIFFERENTIATION OF THE HYDROCHLORIDES OF COCAINE, PROCAINE (NOVOCAINE) AND STOVAINE.—It is important to distinguish between the hydrochlorides of cocaine and procaine considering that both are products possessing analogous properties. Since procaine is cheaper it is often substituted in whole or part for cocaine. Since procaine is not subject to narcotic regulations it is important that there should be a method for detecting the presence of cocaine in it.

Cocaine hydrochloride (chloride of methyl-benzylecgonine) differs essentially from procaine (chloride of para-aminobenzoyl-aminoethanol) in its chemical composition.

Stovaine is the chloride of alpha-dimethylamino-beta-benzoyl pentanol.

Their appearance, organoleptic properties and solubility in various substances does not serve to differentiate between them. Many reactions are common to all particularly with sodium hydroxide, mercuric chloride, potassium iodide, iodine, silver nitrate and mercurous chloride.

The following reactions and properties will serve to distinguish between them:

| | *Procaine* | *Cocaine Chloride* | *Stovaine* |
|---|---|---|---|
| Physical | Needless, colorless inordorous, feebly bitter | Anhydrous crystals, colorless, bitter and no odor. | White crystalline powder inodorous, bitter, acid reaction. |
| Solubility: | | | |
| Water | 1.0 part | 0.75 parts | 2.0 parts |
| Alcohol | 30.0 parts | Soluble in alcohol at 60° C., difficulty soluble in absolute alcohol. | Soluble, less soluble in absolute alcohol. |
| Chloroform | Not very soluble | Soluble | Soluble |
| Ether | Insoluble | Insoluble | Insoluble |
| Carbon disulphide | Insoluble | Almost insoluble | Nearly insoluble |
| Benzol | Id | Insoluble | Id |
| Melting Point | 156° C. | 183° C. | 175° C. |
| Polarization | Inactive | Iævorotatory | Inactive |

| | *Procaine* | *Cocaine Chloride* | *Stovaine* |
|---|---|---|---|
| Reaction | Neutral | Neutral | Acid |
| Reaction with: $NaNO_3+HCl+$ *b*-Naphthol | Scarlet red precipitate | No reaction | No reaction |
| Resorcin+$HNO_3$ fuming | Intense red | Id | Id |
| Phenol | Orange red | Id | Id |
| Pot. Permanganate | Decolorizes rapidly | Decolorizes very slowly | Decolorizes slowly |
| $H_2SO_4+H_2O$ | No odor, no crystals | Odor methyl benzoate and crystals benzoic acid. | Crystals benzoic acid and odor ethyl benzoate |
| $HNO_3$ + KOH | No odor | Benzoic ether | Benzoic ether |
| $NH_4OH$ | Feeble precipitation after several minutes. Liquid opalescent. | Crystallizes immediately. Liquid limpid. | Liquid immediately becomes milky |
| KOH | Oily precipitate becoming crystalline. | White precipitate | White oily precipitate |
| $Na_2B_4O_7$ | No precipitate | White precipitate | White precipitate less soluble than the cocaine |
| $Na_2HPO_4$ | Id | Slight opalescence in concentrated solutions | White milky precipitate |
| $K_4Fe(CN)_6$ | Blue ppt. | No ppt. | Slowly ppts. |
| $K_2CrO_4$ | No ppt. | No ppt. till HCl is added | Oily ppt. dissolves in HCl |
| $AuCl_2$ | Brown precipitate | Light yellow precipitate | Light yellow precipitate. |

The use of the nitric acid and resorcin test will distinguish procaine from cocaine and stovaine and the sodium phosphate reaction will differentiate stovaine from the others. The resorcin reaction of procaine is of use in toxicological analysis it being sensitive to .1 milligram of the anesthetic. The *b*-naphthol and resorcin reactions will detect 0.5 per cent. of procaine in cocaine or stovaine.

The sodium phosphate reaction will detect 10 per cent. of stovaine in procaine or cocaine and the borax and sulphuric acid test will indicate the presence of 10 per cent. of cocaine in novocaine.—(*Journal de pharmacie Belgique*, July, 1921, through *Repertoire de Pharmacie*, November, 1921.)

J. W. E. H.

SIAM BENZOIN.—When Siam Benzoin is dissolved in acetic acid and allowed to stand for several weeks, small colorless crystals of siaresinolic acid are deposited. They correspond to the formula $C_{30}H_{48}O_4$, are monobasic, fuse at 279° C., dextrogyrate in alcoholic solution [$^{(a)}D + 37.79$], soluble in acetic acid, ethyl acetate, salicylate of soda. The acid contains no methoxyl group but forms salts with both sodium and potassium hydrates.

This benzoin also gives crystalline compounds with other substances. Benzoate of lubinol is soluble in the usual organic solvents except ether and petroleum ether. The salt, which is white, melts at 72° C. and is colored green with iron per-chloride and red with sulphuric acid. It has no rotating power and conforms to the formula $C_7H_{16}O_4$. It has the property of fixing one molecule of bromine. Lubinol is an alcohol similar to the coniferyl alcohols.—(*Arch. d. Pharmacie*, 1921, 1, 60; through *Repertoire de Pharmacie*, November, 1921.)

J. W. E. H.

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SOLUBILITY OF SOME DRUGS IN GLYCERIN.—The author has determined the solubility at 20° of a number of pharmaceutical chemicals in glycerin of specific gravity 1.2326 and also 1.2645. The determinations were made by keeping the powdered substance diffused through the glycerin at 20°, withdrawing portions of the solution at intervals and assaying. The results were controlled by dissolving excess of the substance in hot glycerin, cooling, standing until the excess had separated out, and assaying; in the latter case a long time was sometimes necessary for complete separation. The following results were obtained, expressed in grammes of substance dissolved by 100 Gms. of glycerin:

| | Glycerin s.g. 1.2326. | Glycerin s.g. 1.2645. |
|---|---|---|
| Acetanilide | 0.93 | 1.15 |
| Acetyl-salicylic Acid | 0.71 | 0.88 |
| Ammonium Bromide | 31.9 | 27.2 |
| Ammonium Chloride | 12.58 | 10.17 |
| Antipyrine | 21.4 | 17.3 |
| Arsenious Acid | 19.5—25.7 | 35.4—43.5 |
| Benzoic Acid | 1.40—1.45 | 2.20—2.23 |
| Borax | 89 | 111 |

| | Glycerin s.g. 1.2326. | Glycerin s.g. 1.2645. |
|---|---|---|
| Boric Acid | 13.78 | 24.80 |
| Caffeine | 0.59 | 0.47 |
| Calcium Glycerophosphate | 4.15 | 3.98 |
| Camphoric Acid | 2.36 | 4.32 |
| Diethylbarbituric Acid | 0.78 | 0.96 |
| Dimethylamidoantipyrine | 1.9 | 1.5 |
| Hexamethylenetetramine | 26.5 | 20.9 |
| Iodine | 0.47 | 0.67 |
| Lead Acetate | 129 | 143 |
| Mercuric Chloride | 53.5 | 75.3 |
| Potassium Acetate | 77.4 | 65.5 |
| Potassium Bromide | 20.6 | 17.2 |
| Potassium Carbonate | 40.5 | 39.4 |
| Potassium Chlorate | 1.31 | 1.03 |
| Potassium Iodide | 58.3 | 50.6 |
| Quinine | 0.33 | 0.96 |
| Quinine Hydrochloride | 14.3 | 16.8 |
| Quinine Sulphate | 0.72 | 1.31 |
| Salicylic Acid | 0.97 | 1.62 |
| Sodium Benzoate | 31.5 | 28.5 |
| Sodium Bicarbonate | 4.05 | 7.86 |
| Sodium Bromide | 44.7 | 38.7 |
| Sodium Carbonate | 108—123 | 78—102 |
| Sodium Chloride | 10.37 | 8.28 |
| Sodium Glycerophosphate | 79.7 | 82.4 |
| Tartaric Acid | 115.5—161.7 | 69.5—114.7 |

In the case of arsenious acid 20 weeks were found to be insufficient to bring the figures obtained by the cold and by the hot method into agreement; hence both are given. With tartaric acid the figures obtained by the hot method include the acid which had passed into solution in the form of esters.—(*K. Holm* [from *Doctorate Thesis, Amsterdam*]).

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Specially Denatured Alcohol For Perfumery.—The following formula, to be known as specially denatured alcohol Formula 39-B, is authorized for use in the manufacture of perfumes, toilet waters, alcoholic barber supplies and lotions:

To every 100 gallons of pure ethyl alcohol add 2½ gallons of diethylphthalate, $C_6H_4(CO_2C_2H_5)_2$.

Diethylphthalate is colorless, practically without odor, and is miscible with alcohol. Boiling point 290° C.-297° C. The ester content should be not less than 99 per cent., determined by the usual saponification method.

Qualitative detection, fluoresceine test: Take five (5) drops of diethylphthalate or 10 mils of the 2½ per cent. solution, place in a small casserole and add 5 mils of a 10 per cent. solution NaOh. Evaporate practically to dryness on a steam bath and then to complete dryness over a low Bunsèn flame. Continue heating until the mass is in gentle fusion. Discontinue heating and add at once approximately 0.5 Gm. of resorcin. The mass effervesces and turns a dark brown. Place a small portion of this mass in a test tube and add water. The characteristic color of fluoresceine develops at once.

This formula should not be used in preparation of an alkaline character as a chemical reaction will take place, which may be detrimental to the finished product.—(Through *Merck's Report.*)

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Camphor Substitutes.—Camphor substitutes are now being made in quantity in America from coal tar, according to Mr. C. R. De Long, chief chemist of the United States Tariff Commission. In an address delivered recently Mr. De Long said the high price of camphor during the war led to search for a substitute, with the result that triphenyl and ticresyl phosphates were introduced as substitutes for camphor in the manufacture of pyroxylin plastics. The fact that in the past Japan has enjoyed a complete monopoly of the world's supply of camphor was well known. It was extremely doubtful whether these two coal-tar products could replace camphor in pyroxylin plastics for all purposes, but they offered a means of overcoming to some degree the Japanese monopoly in camphor.—(*The Chemical Age,* through *Merck's Report.*)

# NEWS ITEMS AND PERSONAL NOTES

FREE INFORMATION ABOUT SCIENTIFIC INSTRUMENTS AND APPARATUS, LABORATORY CONSTRUCTION AND EQUIPMENT.—The Research Information Service of the National Research Council is prepared to supply to those interested information about scientific instruments, apparatus and supplies, laboratory construction and equipment.

The following are samples of requests answered recently:

"Where may we purchase inexpensive photomicrographic apparatus?"

"Where may a human skull be purchased?"

"Who manufactures a good grade of selenium cells?"

"Advise where lantern slides on European Geography may be obtained?"

"Where may the Lummer-Brodhun cube be obtained?"

"What concern makes gauges recording in fractions of an inch?"

"Where may apparatus and accessories for the study of sensitiveness of photographic plates be secured?"

Address requests: National Research Council,
Information Service, Washington, D. C.

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WHERE TO SECURE RESEARCH CHEMICALS.—A compilation of research chemicals has been prepared by Dr. Clarence J. West for the Committee on Research Chemicals and the Research Information Service of the National Research Council. The American chemical industry has made a very marked advance during the past few years, and a surprisingly large number of high grade chemicals may now be purchased in America. It has seemed desirable to list these with the names of the manufacturers. The addresses of seventy-four firms are given in this compilation and the list of chemicals occupies eighteen pages, while six additional pages are given to biological stains and indicators.

The so called "heavy chemicals" have been omitted because there are so many recognized manufacturers and dealers from whom they may be secured. For the same reason practically all inorganic salts are omitted. The question of whether or not to include dealers who are not manufacturers was decided in the negative because the number of firms which would have to be included would make the list too long for convenient use. It is recognized that the list has many short-comings, but it is believed that it is well worth while to publish it, in order that with the co-operation of manufacturers and users of these chemicals it may be revised and made as nearly complete as possible.

The Committee on Research Chemicals is a committee of the Division of Chemistry and Chemical Technology of the National Research Council, and is composed of the following experts:

Mr. Wm. A. Collins, Chief Chemist, Quality of Water Division, U. S. Geological Survey, Washington.

Dr. Roger Adams, Professor of Organic Chemistry, University of Illinois, Urbana, Ill.

Capt. D. B. Bradner, Chief, Chemical Division, Chemical Warfare Service, Edgewood Arsenal, Edgewood, Md.

Dr. Hans T. Clarke, Research Chemist, Eastman Kodak Co., Rochester, N. Y.

Dr. W. F. Hillebrand, Chief Chemist, Bureau of Standards, Washington, D. C.

Dr. George D. Spencer, Organic Chemist, Analytical Reagent Investigations Laboratory, Bureau, of Chemistry, Washington.

Dr. Clarence J. West, National Research Council, Washington.

Those interested in this booklet should address the Research Information Service, National Research Council, Washington, D. C.

# BOOK REVIEWS

TRAITÈ DE CHIMIE PHARMACEUTIQUE ORGANIQUE. By Maurice Delacre, Professor at the University of Gand. In two parts: Part 1, The Aliphatic Series, pp. 198; part 2, The Aromatic Series, pp. 186; 16 x 23.75 cm. Paris, Librarie Octave, Doin., 1921.

This interesting work follows the orthodox methods of presenting a discussion of the elementary facts and principles of organic chemistry. Stress is naturally laid upon those substances and processes which are of immediate interest to pharmacists while other interesting subjects in organic chemistry are either excluded or are very briefly treated. As an introductory text-book the work will have wide application. The subject matter is wisely chosen and is presented in a simple manner which ought to make it readily intelligible to the student. There is an extensive use of structural formulas arranged so as to be easily understood. Professor Delacre may be complimented upon the lack of complexity in his presentation of some of the more difficult ideas of modern organic chemistry, especially for his discussion of the application of the phase rule to solutions and solubility. The indexing of the two parts is not as extensive as the reviewer would like and the paper used is of poor quality.

J. F. C.

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LES HUILES VÉGÈTALES. By Henri Jumelle, Professor in the Faculty of Marseilles. Paris, Baillière et Fils, 12.5 x 17.5 cm., 496 pages, 1921.

This handy little book comes as a welcome addition to the reference works on the subject of the vegetable oils. The author's purpose is to furnish an essentially practical account of the oils leaving the discussion of the pure chemistry or their constituents to other text-books, of which there are many. Jumelle's book gives the botanical and geographical sources of the oils, the methods employed in their preparation, and the analytical constants

reported. The treatment of many of the subjects is rather brief, but it is not possible in such a general work to devote space to numerous details which are not likely to be of general interest. The book is well indexed, a feature which is not common now-a-days with either French or German publications. The paper and the type leave much to be desired. J. F. C.